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Mechanical Data for Use in Damage Tolerance Analyses

Scott C. Forth
Langley Research Center, Hampton, Virginia

Mark A. James
National Institute of Aerospace
Langley Research Center, Hampton, Virginia

John A. Newman and Richard A. Everett, Jr.
U.S. Army Research Laboratory
Vehicle Technology Directorate
Langley Research Center, Hampton, Virginia

William M. Johnston, Jr.
Lockheed Martin Corporation
Langley Research Center, Hampton, Virginia

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National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23681-2199

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Abstract

This report describes the results of a research program to determine the damage tolerance properties of metallic propeller materials. Three alloys were selected for investigation: 2025-T6 Aluminum, D6AC Steel and 4340 Steel. Mechanical response, fatigue (S-N) and fatigue crack growth rate data are presented for all of the alloys. The main conclusions that can be drawn from this study are as follows. The damage tolerant design of a propeller system will require a complete understanding of the fatigue crack growth threshold. There exists no experimental procedure to reliably develop the fatigue crack growth threshold data that is needed for damage tolerant design methods. Significant research will be required to fully understand the fatigue crack growth threshold. The development of alternative precracking methods, evaluating the effect of specimen configuration and attempting to identify micromechanical issues are simply the first steps to understanding the mechanics of the threshold.

Introduction

The Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA) and the propeller and rotorcraft industries have teamed together to develop methods and guidance for the safe management of high cycle systems using a crack growth based damage tolerance approach. Aircraft propeller and rotorcraft dynamic systems can accumulate millions of vibratory cycles per flight hour. If a crack develops in these systems, the time to failure is extremely short, less than 100 flight hours in most cases, leaving little room for error in the inspection and maintenance processes [1, 2, 3]. A thorough understanding of crack initiation and propagation in these high cycle systems will lead to more focused inspection programs, and ultimately safer aircraft.

Standardized laboratory test methods were co-developed by industry and government, and subsequently written as an ASTM standard [4], in the 1980's to understand crack growth behavior under a variety of loading conditions. One of the primary motivations for a standard test method at the time was the United States Air Force damage tolerance initiative for aircraft fuselage and wing systems [5]. The operating environment, and subsequent loading conditions, for an aircraft fuselage or wing produce significantly fewer cycles than the dynamic system of a propeller or rotorcraft, on the order of hundreds of cycles per flight hour. The standard ASTM test method for crack growth behavior naturally reflects the airframe environment, focusing more on crack propagation than initiation. Recent research has shown that there are issues applying the ASTM standard method for crack growth behavior to develop crack initiation data [6].

In this paper, the authors will present data obtained from three metallic materials commonly found in propeller systems. The data sets will consist of mechanical response, stress-life and fatigue crack growth rate. The stress-life and fatigue crack growth rate data will include the endurance limit and threshold, respectively, which are used to define crack initiation. The authors will comment on the applicability of this data to high cycle fatigue systems and provide guidance to the manufacturers based on the data and observations contained herein.

Material Descriptions

2025-T6 Aluminum Alloy

Aluminum alloy 2025 was developed in the 1930s and is one of the oldest wrought aluminum alloys produced in the United States. This alloy is used almost exclusively by the propeller industry for the manufacture of propeller blades. The chemical composition [7, 8] is listed in Table 1. Test specimens were machined from forged aluminum alloy 2025-T6 propeller spars that were provided by a propeller manufacturer. A photograph of a propeller spar (approximate overall length of 54 inches) is shown in Figure 1. These spars are processed into near-net-shape form, so a finished propeller requires little additional machining. The hub (nearest the center of rotation) and tip (furthest from the center of rotation) regions of the propeller spar are labeled in Figure 1. The hub region of the spar is nearly cylindrical (approximate diameter of 5 inches). Approximately 7 inches from the hub end, the propeller blade begins and the spar is forged into a cross section that is somewhat elliptical and shaped like an airfoil. The orientation of this cross section rotates slightly about the blade neutral axis with distance from the hub, giving the spar a twisted configuration. Each propeller spar is forged from uniform material stock, *e.g.*, cylindrical billets, so the near-tip material is deformed more than the near-hub material during the forging process. Therefore, the near-tip and near-hub material may be different in terms of microstructural character and mechanical performance.

Samples were cut from the near-tip and near-hub regions of a propeller spar for microstructural analysis. Three samples were mounted and polished from each location to obtain the three-dimensional character of the microstructures. Material directions were defined with respect to the local blade geometry (see Figures 2 and 3). The longitudinal direction (L) coincided with the length of the blade. The long-transverse (T) and short-transverse (S) directions coincided with the longest and shortest cross-sectional dimensions, respectively. Each microstructural sample was defined by the direction normal to the exposed plane of the blade. Micrographs of these samples were taken and arranged to appear as a three-dimensional cube to provide visual information about the three-dimensional nature of the microstructure. Metallurgical cubes of the near-tip and near-hub locations are shown in Figures 4(a) and 4(b) respectively.

The propeller spars where cut into compact tension (C(T)), middle-crack tension (M(T)), K_t=1 (stress-life) and tensile specimens to measure specific mechanical properties. Three spars where machined into specimens as shown in Figure 2 to provide fatigue crack growth data. A fourth spar was also machined into $K_t = 1$ stress-life (S-N) and tensile specimens as shown in Figure 3. Location and orientation were maintained in specimen numbering so possible variation of properties with station or blade number could be noted.

D6AC Steel Alloy

D6AC steel is widely used in the aerospace industry. The propeller industry uses this alloy for the attachment of composite propeller blades to the hub/drive-shaft system. The chemical composition [9] of this alloy is listed in Table 2. Test specimens were machined from hammer-forged steel alloy D6AC blocks that were provided by a propeller manufacturer. The details of the heat-treatment and material source are proprietary to the manufacturer. A photograph of a block is shown in Figure 5 for reference. Material directions were defined with respect to the local block geometry (see Figure 6). The longitudinal direction (L) coincided with the length of the block. The long-transverse (T) and short-transverse (S) directions coincided with the longest and shortest cross-sectional dimensions, respectively. These blocks where cut into compact tension (C(T)), middle-crack

tension (M(T)), $K_t = 1$ stress-life (S-N) and tensile specimens to measure specific mechanical properties. All fracture and tension specimens were machined from a single block as shown in Figure 6. Location and orientation of the S-N specimens, which were cut from a second block, is shown in Figure 7. Fracture and tension specimens were numbered as shown in Figure 6. Location and orientation were maintained in specimen numbering so possible variation of properties within the block could be noted.

4340 Steel Alloy

4340 steel is the most commonly used steel alloy in the aerospace industry. The propeller industry uses 4340 steel in the manufacture of hubs/drive-shaft systems in turbo-prop aircraft. The rotorcraft industry uses 4340 steel in the manufacture of transmission systems and other dynamic components. The chemical composition [9] of this alloy is listed in Table 3. Test specimens were machined from hammer-forged steel alloy 4340 blocks that were provided by a propeller manufacturer. The details of the heat-treatment and material source are proprietary to the manufacturer. A photograph of a block is shown in Figure 8. Material directions were defined with respect to the local block geometry (see Figure 6). The longitudinal direction (L) coincided with the length of the block. The long-transverse (T) and short-transverse (S) directions coincided with the longest and shortest cross-sectional dimensions, respectively. These blocks where cut into compact tension (C(T)), middle-crack tension (M(T)), $K_t = 1$ stress-life (S-N) and tensile specimens to measure specific mechanical properties. All fracture and tension specimens were machined from a single block as shown in Figure 6. Location and orientation of the S-N specimens, which were cut from a second block, is shown in Figure 7. Fracture and tension specimens were numbered as shown in Figure 6. Location and orientation were maintained in specimen numbering so possible variation of properties within the block could be noted.

Mechanical Respose

All tensile data reported in this section were conducted in accordance with ASTM standard E8 [10] using 0.5 inch wide rectangular tension specimens, as shown in Figure 9. The specimens were tested in the L, T, and S directions at three test temperatures (-60, 75 and 250 ^{o}F) corresponding to common operating temperatures in propeller systems. Young's modulus, yield stress and ultimate tensile stress were calculated from the test data. Trends observed in the data are reported with each material.

2025-T6 Tensile Testing

Tensile specimens were tested in the L and T directions from various locations in the blade forgings as shown in Figures 2 and 3. Tests were not conducted in the S orientation because specimens in this orientation could not be machined from the product form. Results from the tensile tests are summarized in Tables 4 and 5 and presented in Figure 10. The data shows an expected trend of decreasing ultimate strength with increasing test temperature.

The variation of the room temperature stress-strain results from the four tensile specimens tested with the L orientation is depicted in Figure 11. This figure shows the results from the 75-degree tests and contains one specimen machined from near the hub section of each propeller. This data demonstrates the wide variety in mechanical properties for the material at room temperature. The variations in modulus from these tests bound all of the test data at other temperatures and make it impossible to determine any trends. This indicates that the amount of mechanical work from the forging process might be more of a factor affecting properties than the range of temperatures selected for testing.

D6AC Steel Tensile Testing

Results from the tensile tests are summarized

in Tables 6, 7 and 8 for each of the orientations. Figure 12 plots all of this data showing average values and scatter for the properties measured. A trend of decreasing yield and ultimate strength with increasing test temperature can be seen in all orientation results. The modulus data show very little variation with temperature. Figure 13 shows the variation of stress-strain results from the three tensile specimens tested with the L-orientation at room temperature. The variation of the yield point of specimen number 12 is due to its location near the exterior of the forging. This trend in yield properties was evident for all orientations and temperatures tested as demonstrated by Figure 14 that plots the normalized yield as a function of location for the tensile specimens. The yield values were normalized by the specimen results closest to the center of the forging for each respective orientation and temperature.

4340 Steel Tensile Testing

Results from the tensile tests are summarized in Tables 9, 10 and 11 for each of the orientations. Unfortunately due to testing difficulties three repeats tests were not conducted for all testing conditions. Figure 15 displays plots of all this data showing average values and scatter for the properties measured. A trend of decreasing yield and ultimate strength with increasing test temperature can be seen in all orientation results. The modulus data show very little variation with temperature.

Fatigue (Stress-Life) Data

Stress-life data was generated using axially loaded $K_t = 1$ specimens shown in Figure 16. The gage section of the specimens was finished to a surface roughness of RMS 8. The specimens were cycled at a fully-reversed (R = -1) constant amplitude load. Vibratory stress is computed using the applied load and area of the gage section. Specimens that did not fail after 50,000,000 cycles are considered run-outs. Trends observed in the data are reported with each material.

2025-T6 Fatigue (Stress-Life) Testing

For the 2025-T6 alloy only, the specimen geometry shown in Figure 17 was originally used for testing. However, several grip failures caused a redesign to the specimen geometry shown in Figure 16. The redesigned specimens were machined from the original fatigue specimens and were numbered to preserve the positioning information of the propeller blade. The specimen configuration is noted in the data summary as differentiated in cross-sectional area (Table 12). Figure 18 shows specimen cycles to failure for each of the load levels investigated with an ordinary relationship presented between stress and life, comparable to that found in the literature for aluminums.

D6AC Steel Fatigue (Stress-Life) Testing

The stress-life data is summarized in Table 13. Figure 19 shows specimen cycles to failure for each of the load levels investigated. The L and S orientations were tested and are denoted in the legend of Figure 19 accordingly. The L and S orientation have similar stress-life properties with an ordinary stress-life profile, comparable to that found in the literature for steels.

4340 Steel Fatigue (Stress-Life) Testing

Stress-life data for the 4340 steel is summarized in Table 14. Figure 20 shows specimen cycles to failure for each of the load levels investigated. The L and S orientations were tested and are denoted in the legend of Figure 20 accordingly. The L and S orientation have similar stress-life properties with an ordinary stress-life profile, comparable to that found in the literature for steels.

Fatigue Crack Growth Rate Data

ASTM standard E647 [11] defines the constant K_{max} test procedure to generate

fatigue crack growth threshold data by imposing a constant K_{max} [12, 13] while increasing K_{min}; whereas, the constant R test procedure increases or decreases both K_{max} and K_{min} uniformly [14]. For this study, the dimensions of the C(T) specimens were W = 3.0 inch, B = 0.5 inch, and an initial notch length of 0.75 inch, as shown in Figure 21. The specimens were precracked at a constant ΔK that is equivalent to the first data point in the load reduction test. These loads were applied until the crack length was approximately one-third of the specimen width. The tests were performed in computer controlled servo-hydraulic test machines. The test systems were calibrated to meet or exceed the requirements of ASTM standards E647. The displacement gages and signal conditioners were calibrated to assure linearity in the operating regime. All tests were conducted under K-control with all crack length measurements verified using microscopes on traveling stages. The visual measurements were used to correct the compliance-based crack length values prior to data reporting per ASTM E647. Development of the fatigue crack growth data presented herein was conducted in accordance to ASTM E647 with the following exception: the compact tension specimen notch height exceeded the tolerances set by less than 10%. It is believed that the impact of the out-of-tolerance notch height on the fatigue crack growth data is minimal because the specimens were precracked to a crack length divided by specimen width (a/W) of 0.3 before load reduction testing was performed.

2025-T6 Fatigue Crack Growth Rate Testing

The 2025-T6 specimens were machined from a propeller blade forging as shown in Figure 1. A representative schematic of the specimen layout is shown in Figure 2. The experimental testing for baseline fatigue crack growth rate properties in this report has been performed on laboratory coupons designed to promote mode I crack growth, where cracking is perpendicular to the applied load. However, material microstructure, residual stresses or other factors have caused out-of-plane mixed-mode cracking to occur. ASTM E647, the testing standard used to develop fatigue crack growth rate data, limits the out-of-plane crack growth to within 20 degrees of the specimen symmetry plane to maintain reasonable accuracy of the mode I equations. Cracks with out-of-plane angles less than ten degrees are considered straight. Figure 22 shows the average out-of-plane angle for each of the specimens. The data are cross-referenced to the blade number for each specimen. No obvious correlation exists, but Blade 2 did not produce any straight cracks. For the 45 specimens, there were 12 straight cracks and 18 tests outside the E647 limit of 20 degrees. The remaining specimens were not straight, but were within the 20 degree limit for crack path straightness. Forth, *et al.* [15] examined the nonplanar cracking data and developed a finite element based correction procedure to make use of the data outside the ASTM recommended limits. Lastly, the nonplanar cracking lead to precracking crack growth rates that exceeded the ASTM E647 recommended values for threshold testing because through trial and error it was discovered that a precracking level near a ΔK of 10 ksi $in^{1/2}$ minimized the occurrence of nonplanar crack growth.

2025-T6 Fatigue crack-growth rate data

The fatigue crack growth rate data was generated using fixed stress ratios of 0.5 and 0.7 and using constant K_{max} values of 10, 12.5, 15, 20 and 30 ksi $in^{1/2}$. The specimen test data presented is grouped and plotted based on the L-T and T-L orientations in Figures 23 and 24 respectively. Specimens presented in these plots were tested using the constant R and K_{max} load reduction methods to determine threshold and the constant R load increasing method to determine the upper portion of the crack growth rate curve as indicated by the figure legends. The constant R load reduction test is denoted with "LR." The specimen number is

denoted in the figure legend to correlate test data to blade location (Figure 2). The majority of the constant R, increasing ΔK tests was performed following the constant K_{max} and R load reduction tests. Therefore, duplication of specimen number is seen in the figure legends. Finally, the (*) in the figure legends indicates that the crack plane was between 10 and 20 degrees out of plane. All of the fatigue crack growth rate data is in tabular form in Appendix A. Several other tests were conducted at lower stress ratios. These data are not shown because all of the tests exceeded the ASTM straightness standards. However, these data are discussed in Forth, *et al.* [15]. To properly characterize this material in a laboratory would require significant microstructural evaluation to identify the specimen orientations that would minimize crack turning. However, this exercise would be academic, as a propeller is most likely to be loaded in the material orientations reported herein, not along the weak microstructural planes.

D6AC Steel Fatigue Crack Growth Rate Testing

The D6AC steel specimens were machined from a forged block as shown in Figure 5. A representative schematic of the specimen layout is shown in Figure 6. The fatigue crack growth rate data was generated using fixed stress ratios of 0.9, 0.8, 0.7, 0.3 and 0.1 and using constant K_{max} values of 15, 20 and 30 ksi in$^{1/2}$. The specimen test data presented herein is grouped and plotted based on high and low stress ratios with distinctions being made for the L-T, T-L and S-T orientations. All of the fatigue crack growth rate data is in tabular form in Appendix B.

The fatigue crack growth rate data for the L-T, T-L and S-T orientations at high stress ratios are plotted in Figures 25, 26 and 27 respectively. Data presented in these plots were generated using the constant R and K_{max} test methods as indicated by the figure legends. The fatigue crack growth rate data for the L-T and S-T orientations at R = 0.3 are plotted in Figures 28 and 29 respectively. Data presented in these plots were generated using the constant R test method. The fatigue crack growth rate data generated using the constant R = 0.1 test method for the L-T and S-T orientations are plotted in Figures 30 and 31 respectively. Finally, all filled symbols are data that do not meet the ASTM E647 plastic zone size requirements for remaining ligament. Furthermore, the data that does not meet the ASTM E647 plastic zone size requirements for remaining ligament are italicized Appendix B for clarity.

4340 Steel Fatigue Crack Growth Rate Testing

The 4340 steel specimens were machined from a forged block as shown in Figure 8. A representative schematic of the specimen layout is shown in Figure 6. The fatigue crack growth rate data was generated using fixed stress ratios of 0.7, 0.3 and 0.1 and using constant K_{max} values of 11, 15 and 30 ksi in$^{1/2}$. The specimen test data presented herein is grouped and plotted based on high and low stress ratios with distinctions being made for the L-T, T-L and S-T orientations. All of the fatigue crack growth rate data is in tabular form in Appendix C.

The fatigue crack growth rate data for the L-T, T-L and S-T orientations at high stress ratios are plotted in Figures 32, 33 and 34 respectively. Data presented in these plots were generated using the constant R and K_{max} test methods as indicated by the figure legends. The fatigue crack growth rate data for the L-T and S-T orientations at R = 0.3 are plotted in Figures 35 and 36 respectively. Data presented in these plots were generated using the constant R test method. The fatigue crack growth rate data generated using the constant R = 0.1 test method for the L-T and S-T orientations are plotted in Figures 37 and 38 respectively.

Alternative Fatigue Crack Growth Test Procedures and Observations

The procedure for the development of fatigue crack growth threshold data has been a topic for debate in recent years [16, 17]. The authors have chosen to focus attention on the low stress level (R = 0.1) data generated in the L-T orientation of the two steel alloys to investigate any threshold phenomena. The 2025-T6 aluminum is not studied because of the nonplanar cracking. Compact tension specimens were precracked using a technique where both maximum and minimum loads are compressively applied [18]. This approach to precracking has been used successfully to generate a sharp fatigue crack from a notch. Recent finite element analyses have been used to develop guidelines for loading levels to avoid some of the shortcomings of this procedure [19], such as tensile residual stresses near the notch. All compression precracking performed in this section was performed using a maximum and minimum applied load of -500 and -5000 lbs respectively. The data used herein to compute crack growth rate at a specific value of ΔK is presumed to be unaffected by the compression precracking because the crack length and applied ΔK are outside the influence of the computed residual stress field discussed in James and Forth [19].

D6AC steel alternative fatigue crack growth data

Standard fatigue crack growth threshold data is generated using constant stress-ratio and constant maximum stress-intensity tests. These data are then used to formulate an effective stress-intensity solution. Using the effective solution as a predictive tool [20], as shown in Figure 39, low stress-ratio testing was conducted using a compressive precracking scheme. The effective stress-intensity solution has previously proven accurate in predicting fatigue crack growth rates in several steel, aluminum and titanium alloys [20, 21]. In particular, for 4340 steel, constant R load reduction data using middle-through crack specimens agrees with AGARD [22] small crack data. However, recent compact tension data of 4340 steel (Figure 37) from the constant R load reduction procedure shows elevated low R thresholds. The standard and alternative data both generated on D6AC steel using compact tension specimens resulted in a very high threshold at a low stress-ratio in comparison to the predictions, as shown in Figure 39. The baseline fatigue crack growth data used for discussion in this section is the constant R = 0.1 load reduction data generated using specimen number 8 in the L-T orientation. The constant ΔK data in Figure 39 was generated using compression precracking, followed by constant ΔK testing at 4, 5 and 7 ksi $in^{1/2}$. The constant ΔK tests conducted at 4 and 5 ksi $in^{1/2}$ initiated cracks that later arrested. Crack arrest was determined to occur when the crack growth rate fell below 10^{-9} inches/cycle. A plot of the crack growth versus cycle count for these two tests is shown in Figure 40. The lines drawn through the data indicate where the growth rate was computed for each test. An additional result in Figure 40 is for a test with compression precracking followed by constant load amplitude starting at ΔK = 3.6 ksi $in^{1/2}$. The crack grew 0.0025 inches and arrested after approximately one million cycles. Specimen number 32 was then used for a constant ΔK = 7 ksi $in^{1/2}$ test as discussed later.

Two tests were conducted with compression precracking followed by constant ΔK = 7 ksi $in^{1/2}$. Specimen number 31 was precracked, propagated at a constant ΔK = 7 ksi $in^{1/2}$ for 0.0698 inches, a constant R = 0.1 load reduction test was performed for the next 0.8978 inches, and finally another constant ΔK = 7 ksi $in^{1/2}$ was performed for 0.0985 inches. The data from these tests is plotted in Figure 41 as crack growth versus cycles to highlight the computation of crack growth rate during the two constant ΔK regimes. The constant ΔK = 7 ksi $in^{1/2}$ crack growth rate proceeding the load reduction test is nearly double the ΔK = 7 ksi $in^{1/2}$ crack growth rate following load reduction. This reduction in crack growth rate

for the second constant ΔK = 7 ksi $in^{1/2}$ segment may be attributable to mechanisms retarding the crack [20]. First, the crack path was studied and crack tunneling was noted which could retard the crack. And secondly, crack closure may have an influence on the crack growth rate. The closure measurements (2% offset) taken during the test are plotted in Figure 42 versus crack length. There appears to be no closure detected in either test, indicating that something other than crack closure that is measurable with compliance is causing the variability in crack growth rate of this specimen. It has been postulated in the literature that intergranular crack growth dominates the threshold regime of D6AC steel [23]. It is entirely possible that this mechanism is being activated in this test, however the authors have no evidence to either support or deny this hypothesis. Therefore, a second constant ΔK = 7 ksi $in^{1/2}$ test was performed using specimen number 32, as shown in Figure 43. The fatigue crack growth rate determined from extensive crack growth (> 0.50 inches) generated a fatigue crack growth rate similar to that of specimen number 31 after the threshold test was conducted. Based on this test, it may be possible to imply that steady-state condition was not developed during the initial constant ΔK = 7 ksi $in^{1/2}$ test on specimen number 31.

A standard test was conducted using specimen number 28 to determine a baseline. The precracking was performed in tension at a constant ΔK = 10.8 ksi $in^{1/2}$. Then a constant R = 0.1 load reduction test was performed to a ΔK of approximately 7.0 ksi $in^{1/2}$ where a constant ΔK = 7.0 ksi $in^{1/2}$ was performed. After the crack propagated approximately 0.14 inches, a constant ΔK = 7.6 ksi $in^{1/2}$ test was performed for 0.074 inches. Subsequently a constant ΔK = 8.7 ksi $in^{1/2}$ and constant ΔK = 9.7 ksi $in^{1/2}$ tests were performed consuming approximately 0.064 inches of the specimen each. A plot of these tests as crack length versus cycles is shown in Figure 44.

Finally, a comparison of the fatigue crack growth rate data for each of these tests to the baseline data is presented in Figure 45. There is little difference in crack growth rate between the experimental approaches presented herein. This would imply that the threshold value of 5.9 ksi $in^{1/2}$ derived in this paper is an accurate representation of the D6AC steel alloy. However, the authors believe that this threshold value is higher than should be expected for this material. Literature data suggests that the 3 inch compact tension specimen may be promoting higher threshold phenomena because of constraint [24], T-stress [25] and micromechanical issues [23]. The authors are continuing to evaluate this material with future testing of alternate specimen configurations and sizes. The fatigue crack growth data for specimen numbers 28, 31 and 32 are in tabular form in Appendix C.

4340 steel alternative fatigue crack growth data

To evaluate the fatigue crack growth threshold data developed herein, 4340 steel data obtained in the literature [22] is used as a baseline. The data was generated using the constant R load reduction data with middle-through crack specimens. The standard data generated on 4340 steel using compact tension specimens resulted in a very high threshold at a low stress-ratio in comparison to the literature data, as shown in Figure 46. The baseline fatigue crack growth data used for discussion in this section is the constant R = 0.1 load reduction data generated using specimen number 28 in the L-T orientation.

Using the literature data as a guide, specimen number 9 was compression precracked then switched to tension where a constant ΔK of 5.89 ksi $in^{1/2}$ test was conducted for 0.26 inches. Unfortunately, the crack front grew out-of-straightness (side to side) and arrested. However, the data generated during the constant ΔK test agreed very well with the literature data, even though this ΔK level is below the threshold obtained from the load reduction test, as shown in Figure 46. A

constant ΔK of 9.8 ksi $in^{1/2}$ test was then conducted in an attempt to straighten the crack front. The crack front returned to straightness within 0.05 inches then constant ΔK of 9.8 ksi $in^{1/2}$ data was recorded for 0.20 inches. A constant R = 0.1 load reduction test was then performed until the crack arrested at a ΔK of 7.34 ksi $in^{1/2}$. Crack arrest was determined to occur when the crack growth rate fell below 10^{-9} inches/cycle. A plot of the crack growth versus cycle count for these tests is shown in Figure 47. The lines drawn through the data indicate where the growth rate was computed for each test.

Specimen number 25 was also compression precracked and subsequently tested at a constant ΔK of 5.90 ksi $in^{1/2}$, as shown in Figure 48. The crack propagated for 0.20 inches under constant ΔK and was flipped in the test stand to preempt any crack front straightness issues similar to specimen number 9. Fortunately, the crack propagated straight throughout the entire test. The crack growth rate computed from the constant ΔK of 5.90 ksi $in^{1/2}$ test also matches the literature data well. A constant R = 0.1 load reduction test was then conducted, where the crack arrested at a ΔK of 5.90 ksi $in^{1/2}$. A constant ΔK of 7.0 ksi $in^{1/2}$ test was then conducted. The crack did not propagate for nearly 3 million cycles then began to propagate at a rate of 3.35×10^{-8} inches/cycle and finally arrested. The reasons for the delay and subsequent arrest are currently unknown. The fatigue crack growth data for specimen numbers 9 and 25 are in tabular form in Appendix E.

Discussion

The aluminum alloy 2025-T6 has been used for decades to manufacture propeller blades. This alloy is the foundation of propeller design that newer systems, such as composite propellers with D6AC steel retention systems, have built. 4340 steel has been used with success as a propeller hub material. The commonality between the two steel alloys is evident in the low strength heat treatment, compared to the strengths prevalent in the aerospace industry, and both steels being used for thin-walled structure machined from thick forgings. Therefore, a comparison of the trends observed in the testing of the steels is reasonable. Of all the test data reported in this document, only the fatigue crack growth rate data exhibited unexpected results. A comment on each material and the data follows.

Fatigue crack growth threshold testing 2025-T6 aluminum alloy generated mixed-mode cracking because of weak microstructural planes induced during the forging process. The out-of-plane cracking led to a significant portion of the test program being outside the ASTM guidelines for crack path straightness. A simple approach was devised using finite element analysis to adjust the data for mode-mixity with some success, found in Forth, *et al* [15]. With the unintended focus of the 2025-T6 being on mixed-mode crack growth, very little knowledge was gained about the fatigue crack growth threshold.

The fatigue crack growth threshold testing of the D6AC steel alloy led to a large fanning of threshold values based on stress ratio. It has been postulated in the literature [16, 17, 20] that remote plasticity-induced crack closure is causing the constant R load reduction test method to produce artificially high threshold data. Compression precracking was used in combination with constant ΔK testing in an attempt to explain the variability at threshold using plasticity induced closure theory. The compression precracking method is positioned as an alternative means to generate near-threshold data without remote closure at low stress ratios. For the D6AC steel, several of the compression precracked specimens were tested at ΔK values below the threshold determined using the standard constant R load reduction method (R = 0.1). In each case, the crack propagated for nearly 0.1 inches then arrested. It is important to note that the compression precracking procedure imparts a tensile residual stress in the specimen [19] that can result in higher growth rates than

anticipated. However, the effects of the residual stresses imparted in these tests should not have affected the crack for 0.1 inches. Furthermore, plasticity theory would indicate that steady-state closure would have developed long before the crack arrested. Therefore, there must be another explanation for the crack arrest during the constant ΔK tests and the elevated thresholds obtained from the constant R load reduction tests. It has been postulated in the literature [23], and independently from a propeller manufacturer, that intergranular crack growth can occur near threshold in this alloy. The transition from transgranular crack growth to intergranular may explain the crack arrest witnessed in this test program, as intergranular cracking is typically at a much slower rate [23]. However, there were no measurements taken during this test program to confirm this theory. Other explanations for the arrest of the cracks are environmental effects such as crack face oxidation, and roughness-induced crack closure. In each test conducted at low stress ratios (R = 0.1 and 0.3), a visual examination of the fracture surface revealed a "darkening" near threshold, indicating oxide residue build-up. Measurements were not taken to quantify the level of oxide residue present. It is also plausible that roughness-induced closure caused the cracks to arrest. However, the fracture surfaces visually appear smooth, since the grain size of D6AC steel is relatively small and large asperities were not clearly visible on the fracture surface, therefore roughness-induced closure may not be substantial.

The fatigue crack growth threshold testing of the 4340 steel alloy led to an even larger fanning of the threshold than the D6AC. Once again, compression precracking was used to generate crack growth data near threshold for R = 0.1. In each load reduction test, the crack growth rate dropped dramatically, *e.g.* the slope of the da/dN vs. ΔK curve was nearly infinite, indicating rapid crack arrest similar to the D6AC data. Constant ΔK = 5.90 ksi $in^{1/2}$ testing, below the threshold of 7.34 ksi $in^{1/2}$ determined from the constant R load reduction tests, was conducted on two compression precracked specimens resulting in stable crack growth for more than 0.2 inches. In one case, a constant R load reduction test was conducted after the constant ΔK = 5.90 ksi $in^{1/2}$ test resulting in the crack arresting at a ΔK of 5.90 ksi $in^{1/2}$. The rapid arrest of the crack was similar to that of the standard constant R load reduction tests conducting using tensile precracking indicating the crack arrest mechanisms are similar. Subsequent testing of this specimen at ΔK = 7.0 ksi $in^{1/2}$ test was then conducted. The crack did not propagate for nearly 3 million cycles then began to propagate at a rate of 3.35×10^{-8} inches/cycle and finally arrested. The reasons for the delay and subsequent arrest are currently unknown. The same hypotheses drawn for the arrest of the D6AC steel data (oxide- or roughness-induced crack closure, intergranular crack growth, specimen configuration) could be applicable to the 4340. Once again, significant research will be needed to explain to explain the fatigue crack growth threshold behavior of 4340 steel.

Conclusions

The intent of this paper was to develop damage tolerance data and guidance for its application for the FAA and propeller industry. Data characterizing the mechanical response, stress-life and fatigue crack growth rate behavior for 2025-T6 aluminum, D6AC and 4340 steel was developed. The mechanical response and stress-life data generated has a high confidence level of the authors. However, the questions surrounding the validity of the fatigue crack growth rate data presented in this paper cannot be ignored. It is the authors' opinion that there currently is not a simple set of criteria to define high confidence fatigue crack growth rate data. Therefore, the authors would recommend any party interested in using the fatigue crack growth rate data presented herein, for any of the materials, to contact one of the authors of this paper for guidance.

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Table 1. Chemical composition of 2025 aluminum alloy.

Element	Symbol	2025 Aluminum
Aluminum	Al	Balance
Chromium	Cr	0.1%
Copper	Cu	3.9-5.0%
Iron	Fe	1%
Magnesium	Mg	0.05%
Manganese	Mn	0.4-1.2%
Silicon	Si	0.5-1.2%
Titanium	Ti	0.15%
Zinc	Zn	0.25%

Table 2. Chemical composition of steel alloy D6AC.

Element	Symbol	D6AC steel
Carbon	C	0.45-0.50%
Chromium	Cr	0.90-1.20%
Copper	Cu	< 0.35%
Iron	Fe	balance
Manganese	Mn	0.60-0.90%
Molybdenum	Mo	0.90-1.10%
Nickel	Ni	0.40-0.70%
Phosphorous	P	< 0.015%
Silicon	Si	0.15-0.30%
Sulphur	S	< 0.015%
Vanadium	V	0.08-0.15%

Table 3. Chemical composition of steel alloy 4340.

Element	Symbol	D6AC steel
Carbon	C	0.38-0.43%
Chromium	Cr	0.70-0.90%
Iron	Fe	balance
Manganese	Mn	0.60-0.80%
Molybdenum	Mo	0.20-0.30%
Nickel	Ni	1.65-2.00%
Phosphorous	P	< 0.035%
Silicon	Si	0.15-0.30%
Sulphur	S	< 0.040%

Table 4. 2025-T6 tensile data from the L-orientation.

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T2-L-B1	-60	10.4	43.9	59.9
T6-L-B4	-60	10.3	44.5	61.7
T9-L-B4	75	10.3	42.9	61.1
T1-L-B1	75	11.0	42.9	57.7
T1-L-B2	75	11.3	43.6	59.5
T1-L-B3	75	10.9	45.4	62.7
T1-L-B4	250	10.3	40.7	52.6
T7-L-B4	250	10.5	43.4	55.2
T2-L-B2	250	10.8	40.9	52.6
T2-L-B3	250	10.3	42.1	52.6

Table 5. 2025-T6 tensile data from the T-orientation.

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T4-T-B4	-60	10.0	41.5	61.2
T3-T-B4	75	11.1	43.3	60.8
T5-T-B4	250	11.2	43.0	50.2

Table 6. D6AC tensile data from the L-orientation.

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-L-D6AC-F1	-60	33.9	168.8	190.0
T-7-L-D6AC-F1	-60	30.2	168.1	188.1
T-11-L-D6AC-F1	-60	31.3	177.7	191.6
T-1-L-D6AC-F1	75	30.5	160.5	178.1
T-6-L-D6AC-F1	75	30.2	160.6	179.7
T-12-L-D6AC-F1	75	30.7	166.7	179.7
T-2-L-D6AC-F1	250	30.9	151.7	174.5
T-5-L-D6AC-F1	250	30.1	150.2	173.9
T-10-L-D6AC-F1	250	30.7	155.8	176.9

Table 7. D6AC tensile data from the T-orientation.

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-T-D6AC-F1	-60	30.8	170.7	190.9
T-7-T-D6AC-F1	-60	30.9	167.1	188.1
T-11-T-D6AC-F1	-60	31.1	175.6	191.8
T-1-T-D6AC-F1	75	30.9	164.3	182.5
T-6-T-D6AC-F1	75	30.4	164.0	181.8
T-12-T-D6AC-F1	75	31.5	170.6	184.4
T-2-T-D6AC-F1	250	30.1	152.6	177.0
T-5-T-D6AC-F1	250	30.5	154.2	176.5
T-10-T-D6AC-F1	250	31.0	156.9	177.8

Table 8. D6AC tensile data from the S-orientation.

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-S-D6AC-F1	-60	30.5	167.4	187.5
T-7-S-D6AC-F1	-60	31.3	167.7	188.1
T-11-S-D6AC-F1	-60	30.4	173.8	189.6
T-1-S-D6AC-F1	75	31.1	160.2	178.9
T-6-S-D6AC-F1	75	30.7	159.9	179.2
T-12-S-D6AC-F1	75	31.1	171.5	183.0
T-2-S-D6AC-F1	250	30.9	152.3	176.7
T-5-S-D6AC-F1	250	30.9	148.6	171.4
T-10-S-D6AC-F1	250	30.9	152.9	174.7

Table 9. 4340 tensile data from the L-orientation.

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-L-4340-F1	-60	30.9	78.6	116.3
T-7-L-4340-F1	-60	30.4	78.8	118.2
T-11-L-4340-F1	-60	29.8	77.4	116.0
T-1-L-4340-F1	75	30.6	71.8	105.1
T-6-L-4340-F1	75	30.2	72.8	106.0
T-12-L-4340-F1	75	30.5	73.2	106.8
T-2-L-4340-F1	250	30.0	69.6	101.0
T-5-L-4340-F1	250	30.4	69.2	100.8
T-10-L-4340-F1	250	29.6	67.5	99.4

Table 10. 4340 tensile data from the T-orientation.

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-T-4340-F1	-60	33.5	78.4	115.9
T-7-T-4340-F1	-60	30.5	78.0	116.5
T-11-T-4340-F1	-60	30.0	77.8	116.5
T-1-T-4340-F1	75	30.6	75.0	108.5
T-6-T-4340-F1	75	30.5	-	-
T-2-T-4340-F1	250	30.3	69.5	101.0
T-5-T-4340-F1	250	29.8	69.6	101.0
T-10-T-4340-F1	250	30.6	69.2	100.9

Table 11. 4340 tensile data from the S-orientation.

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-S-4340-F1	-60	30.9	87.6	119.2
T-7-S-4340-F1	-60	30.4	78.7	116.3
T-11-S-4340-F1	-60	30.2	78.7	116.6
T-1-S-4340-F1	75	30.8	72.1	105.5
T-6-S-4340-F1	75	30.8	74.1	107.3
T-12-S-4340-F1	75	30.2	73.7	107.3
T-2-S-4340-F1	250	31.6	69.3	100.1
T-5-S-4340-F1	250	30.7	69.8	101.2

Table 12. 2025-T6 stress-life (S-N) data from the L-orientation (R = -1).

Specimen ID	Cross-sectional area (in^2)	Vibratory stress (ksi)	Cycles to failure
SN-17B-L-B-4	0.100	50.0	3,076
SN-16B-L-B-4	0.101	50.0	7,775
SN-19A-L-B-4	0.100	50.0	2,684
SN-17A-L-B-4	0.101	40.0	30,528
SN-14A-L-B-4	0.099	40.0	24,958
SN-21B-L-B-4	0.101	40.0	28,480
SN-15-L2-B-4	0.120	30.0	118,100
SN-16A-L-B-4	0.100	30.0	101,450
SN-21A-L-B-4	0.100	29.9	137,539
SN-18B-L-B-4	0.100	25.0	6,113,880
SN-9B-L-B-4	0.100	25.0	9,541,822
SN-14B-L-B4	0.100	20.0	37,801,084
SN-10A-L-B4	0.101	19.9	> 53,507,408
SN-22B-L-B4	0.099	18.1	46,890,132
SN-9A-L-B4	0.099	18.1	> 50,394,272
SN-4-L-B-4	0.500	18.0	> 50,000,000
SN-5-L-B-4	0.500	18.0	> 50,000,000
SN-24-L-B-4	0.500	18.0	> 50,577,015

Table 13. D6AC stress-life (S-N) data (R = -1).

Specimen ID	Vibratory stress (ksi)	Cycles to failure
L-14	120.0	27,344
L-15	120.0	26,466
L-9	100.0	53,573
L-5	100.0	68,914
L-10	90.0	142,321
L-4	90.0	147,276
L-11	80.0	505,442
L-7	80.0	5,530,634
L-8	75.0	6,912,899
L-1	75.0	50,000,000
L-12	75.0	50,249,756
S-15	110.0	43,651
S-11	110.0	28,550
S-12	100.0	56,235
S-8	100.0	67,309
S-2	90.0	69,257
S-5	90.0	78,255
S-4	90.0	91,858
S-6	85.0	90,308
S-1	85.0	99,230
S-14	80.0	160,996
S-7	80.0	359,259
S-9	80.0	50,025,520
S-13	75.0	50,091,378

Table 14. 4340 stress-life (S-N) data (R = -1).

Specimen ID	Vibratory stress (ksi)	Cycles to failure
L-11	70.00	1,590
L-2	69.96	1,102
L-12	60.02	33,632
L-9	60.02	30,218
L-4	59.98	33,527
L-3	50.02	399,506
L-13	49.97	428,535
L-6	49.97	318,046
L-7	40.00	50,000,000
L-5	39.98	50,737,500
L-10	39.96	50,828,956
S-9	70.00	1,563
S-11	70.00	2,046
S-15	69.90	1,596

S-1	60.00	37,197
S-5	60.00	27,462
S-3	60.00	35,888
S-4	50.00	270,658
S-6	49.99	934,709
S-12	49.99	460,528
S-10	47.50	675,451
S-14	47.51	41,671,388
S-13	47.47	14,479,157
S-7	45.00	50,142,524
S-8	44.97	50,081,820
S-2	44.95	50,018,000

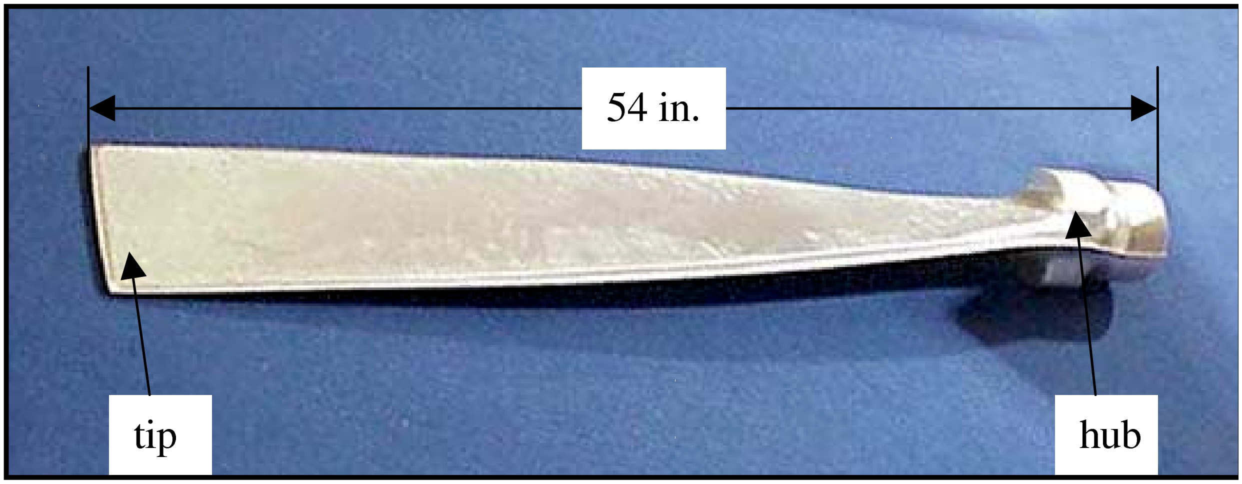


Figure 1. Photograph of propeller spar forging made of aluminum alloy 2025.

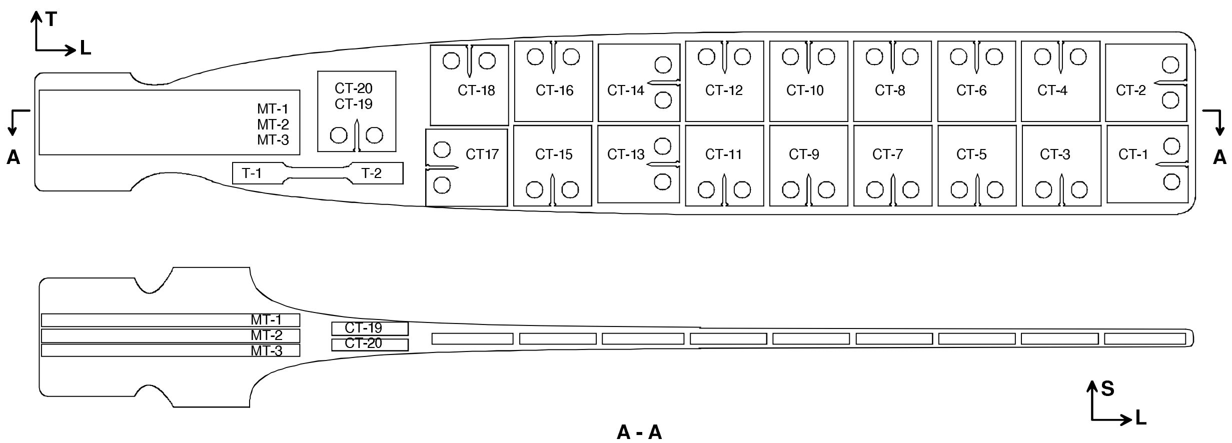


Figure 2. The location and orientation of fatigue crack growth specimens, with respect to the propeller spar forgings, shown schematically for blade numbers 1,2 and 3.

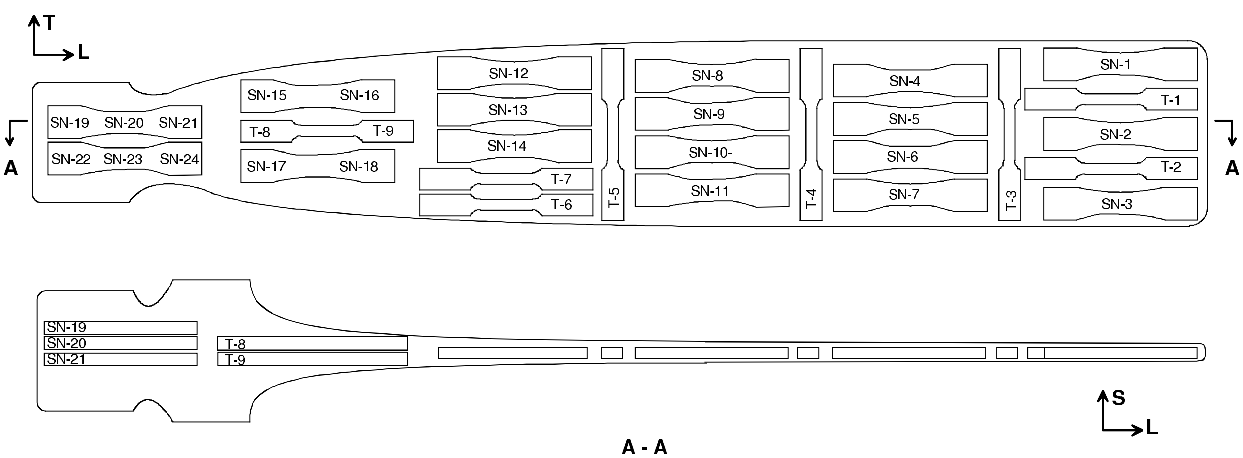


Figure 3. The location and orientation of tensile and uniaxial fatigue (S-N) specimens, with respect to the propeller spar forgings, shown schematically for blade 4.

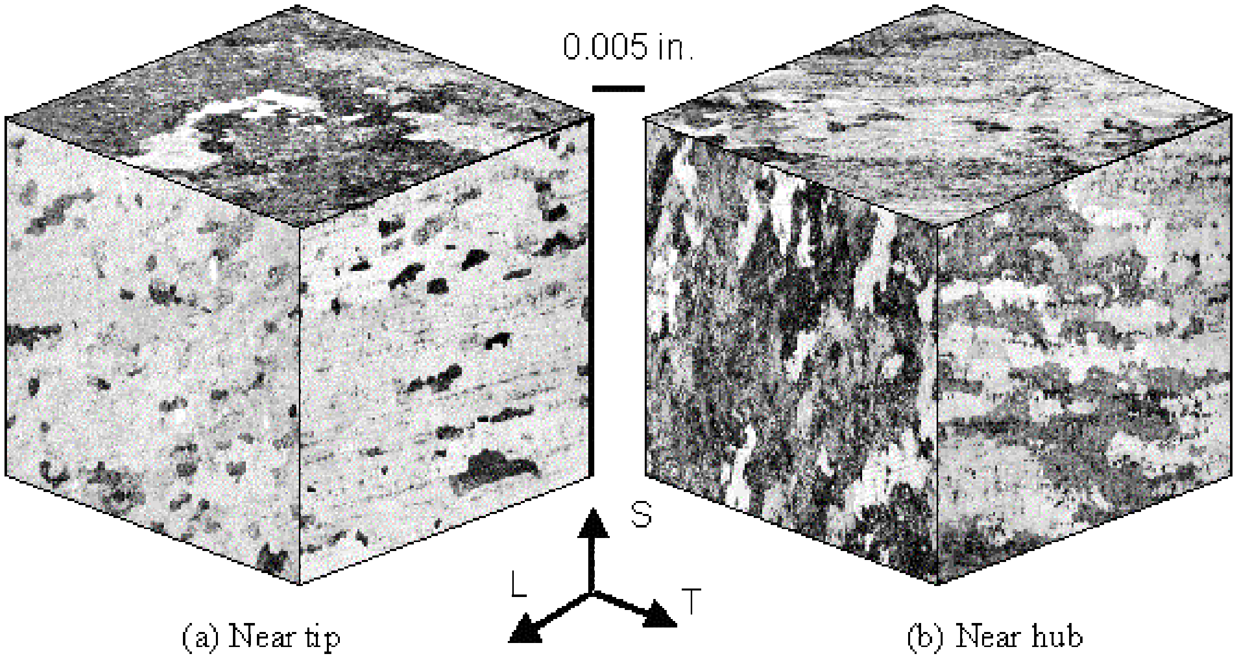
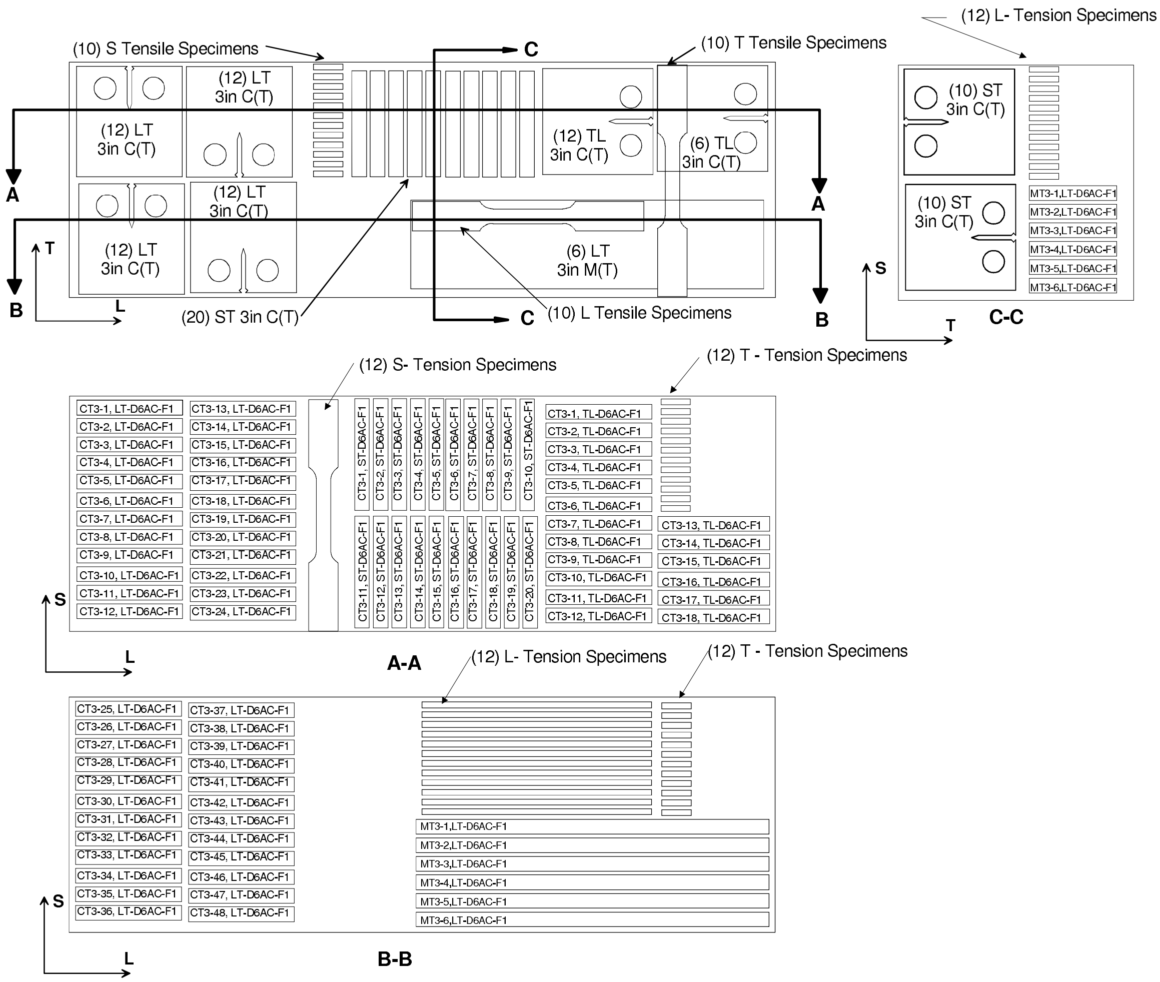


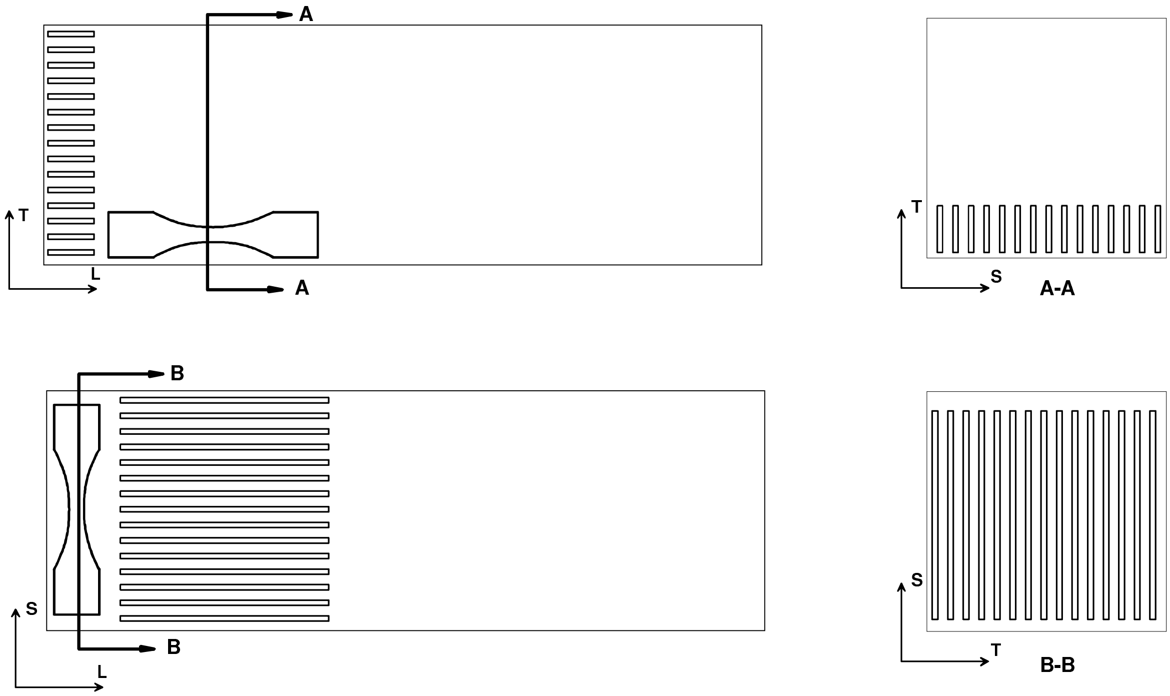
Figure 4: Orthogonal metallurgical cubes are shown for propeller spar material (a) near the tip and (b) near the hub.

Figure 5: Photograph of forging made of steel alloy D6AC.



NOTE:Tensile specimens numbered starting with 1 at the centerline of the forging and 12 farthest from the centerline.

Figure 6: The location, numbering and orientation of fracture and tension specimens, with respect to the forging, shown schematically.



NOTE: Specimens numbered consecutively from one edge to the other with specimen 8 from the mid plane.

Figure 7: The location, numbering and orientation S-N specimens, with respect to the forging, shown schematically.

Figure 8: Photograph of forging made of steel alloy 4340.

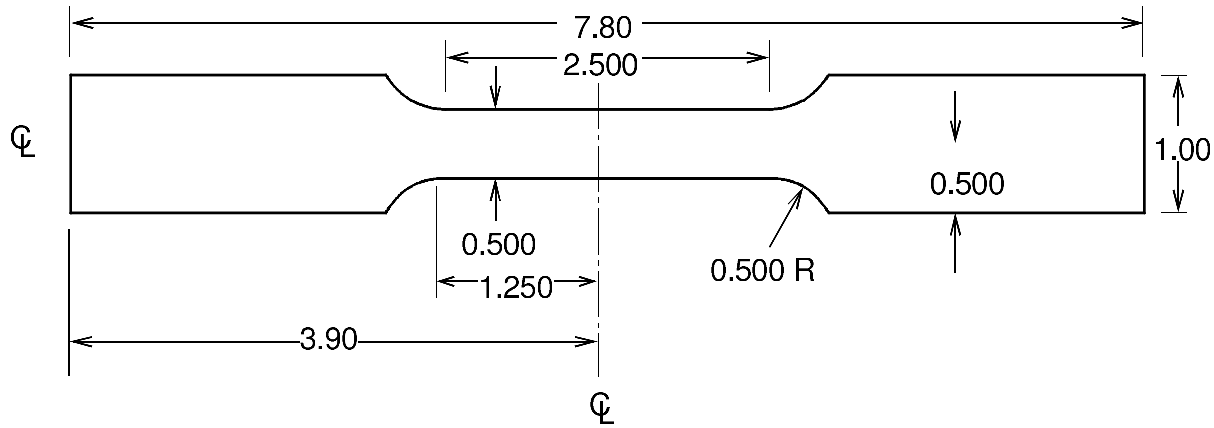


Figure 9: Dimensions of tensile specimen used for static tests (All dimensions are inches).

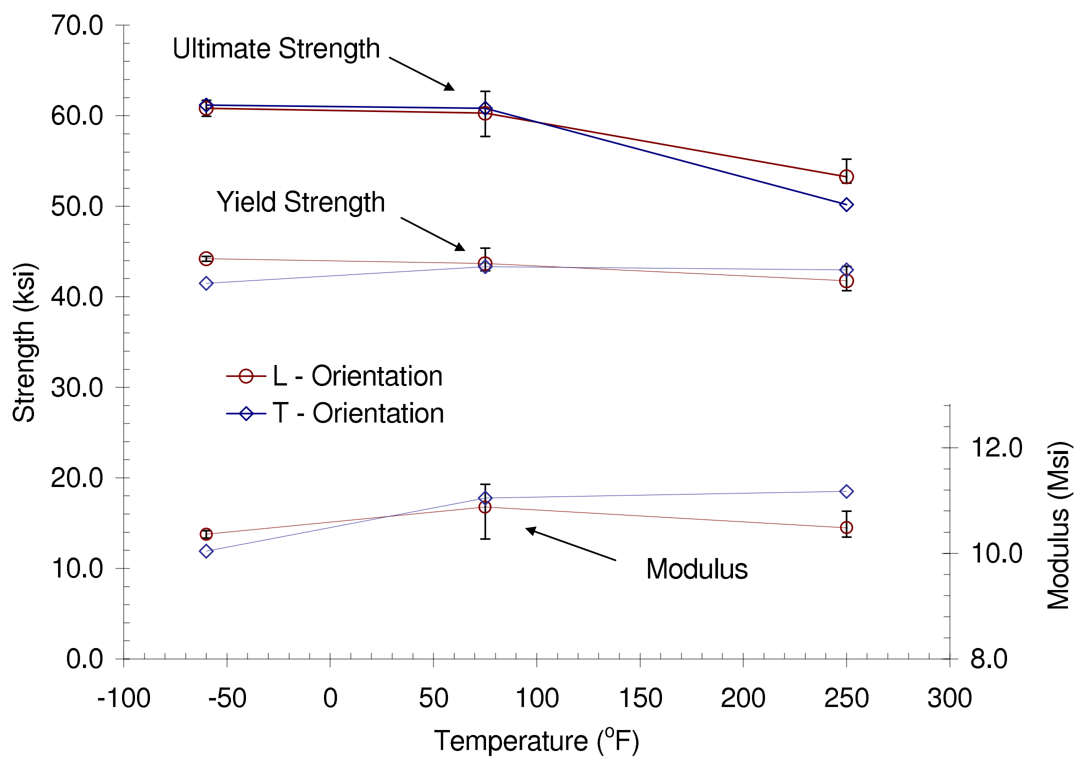


Figure 10: Average measured tensile properties for 2025 tested. Scatter bars are shown for L orientation.

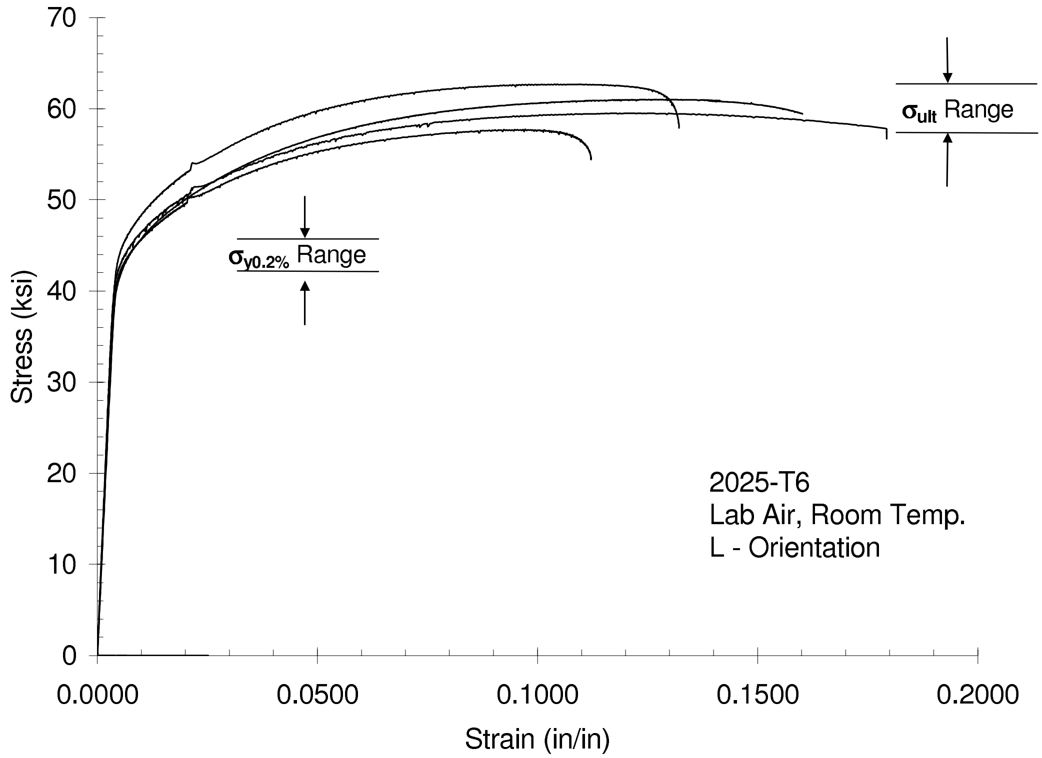


Figure 11: Stress strain variation for the L orientation tested at room temperature (2025-T6).

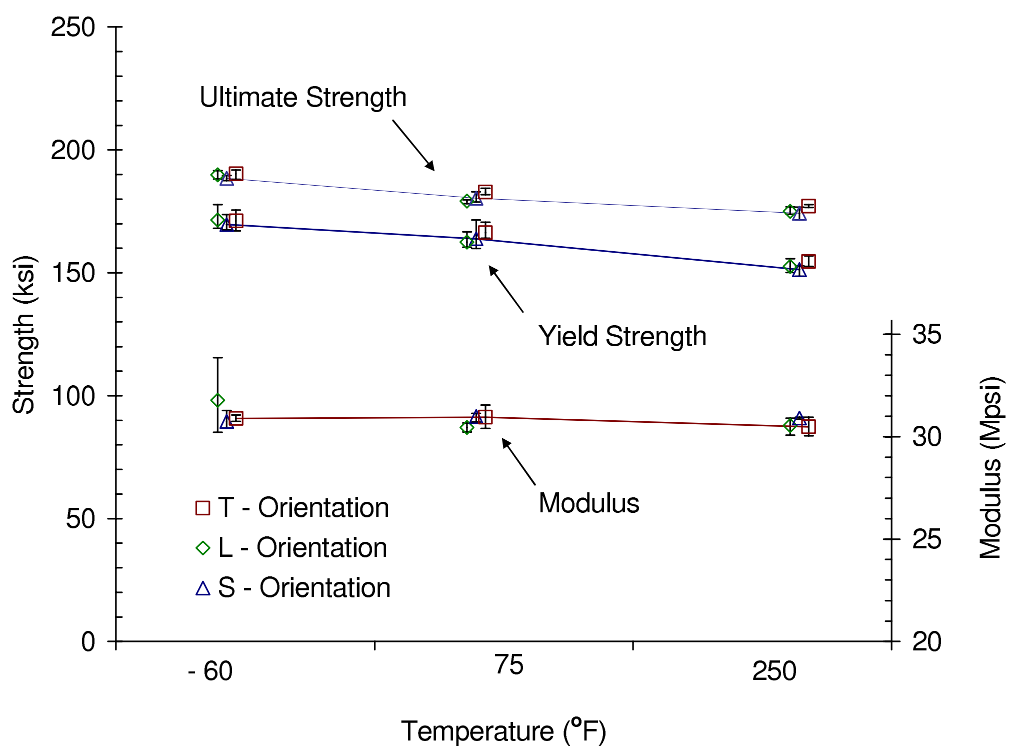


Figure 12: Average measured tensile properties for D6AC all orientations tested.

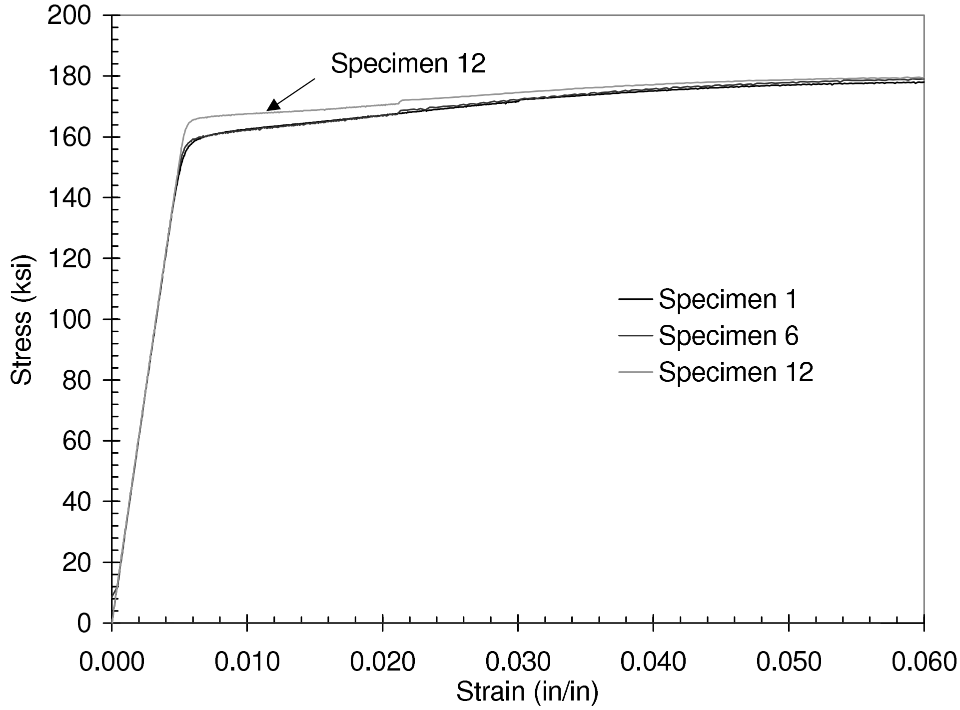


Figure 13: Average measured tensile properties for D6AC L-orientation tested.

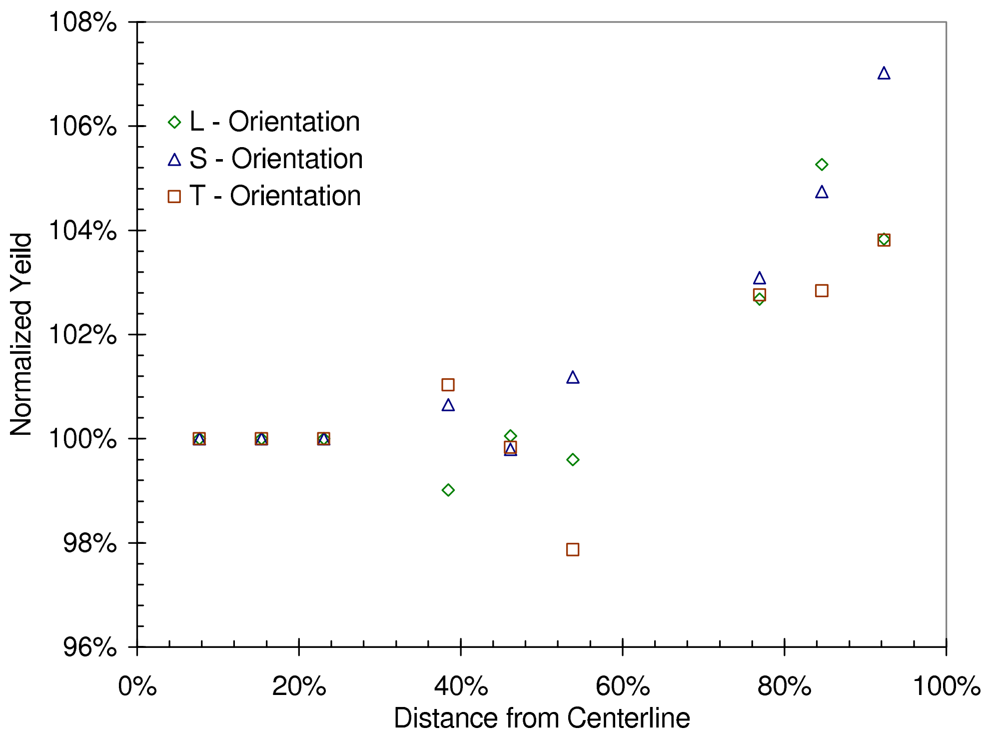


Figure 14: Stress strain variation through the forging at room temperature (D6AC).

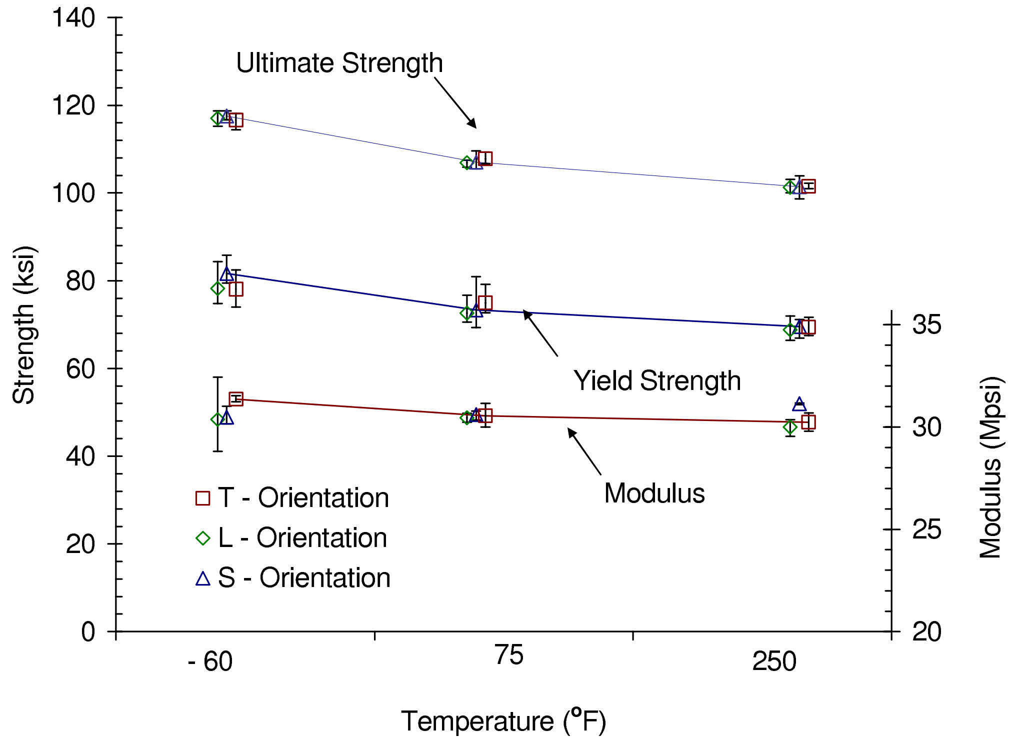


Figure 15: Average measured tensile properties for 4340 tested.

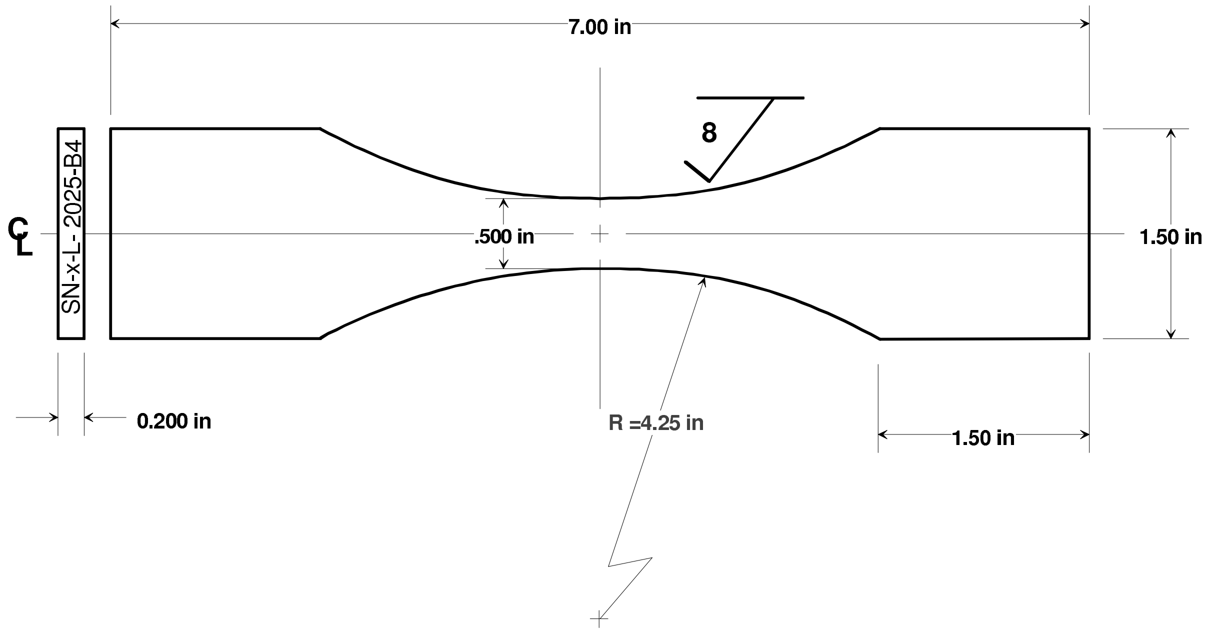


Figure 16: Fatigue (stress-life) specimen.

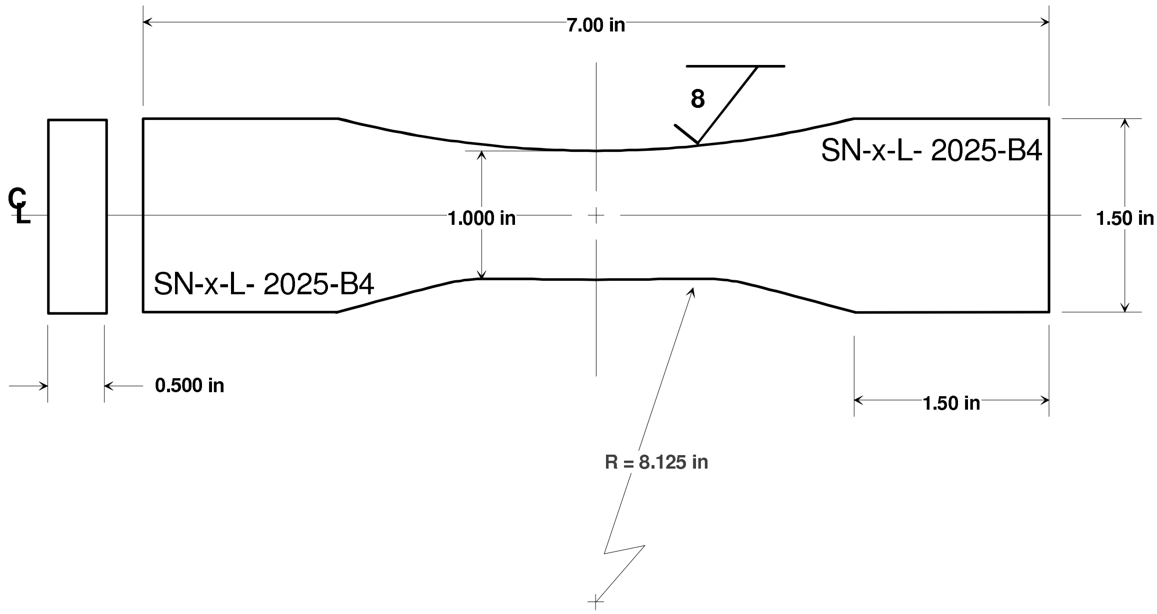


Figure 17: Original fatigue (stress-life) specimen.

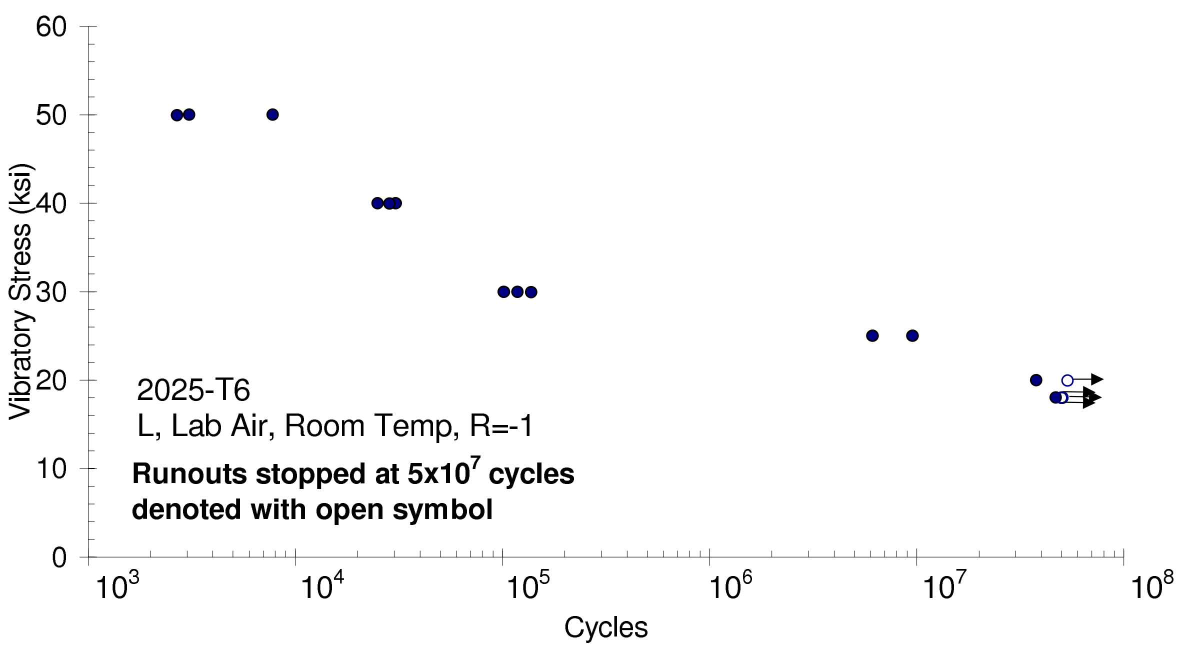


Figure 18: Fatigue (stress-life) data for aluminum alloy 2025-T6.

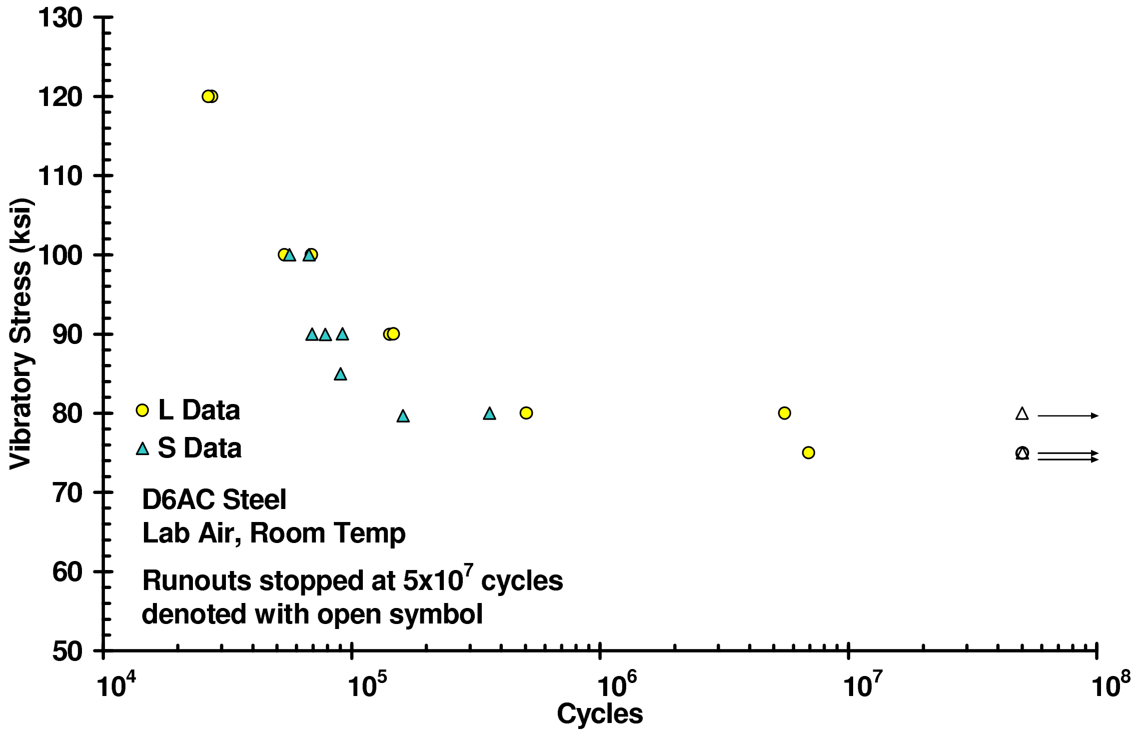


Figure 19: Fatigue (stress-life) data for steel alloy D6AC.

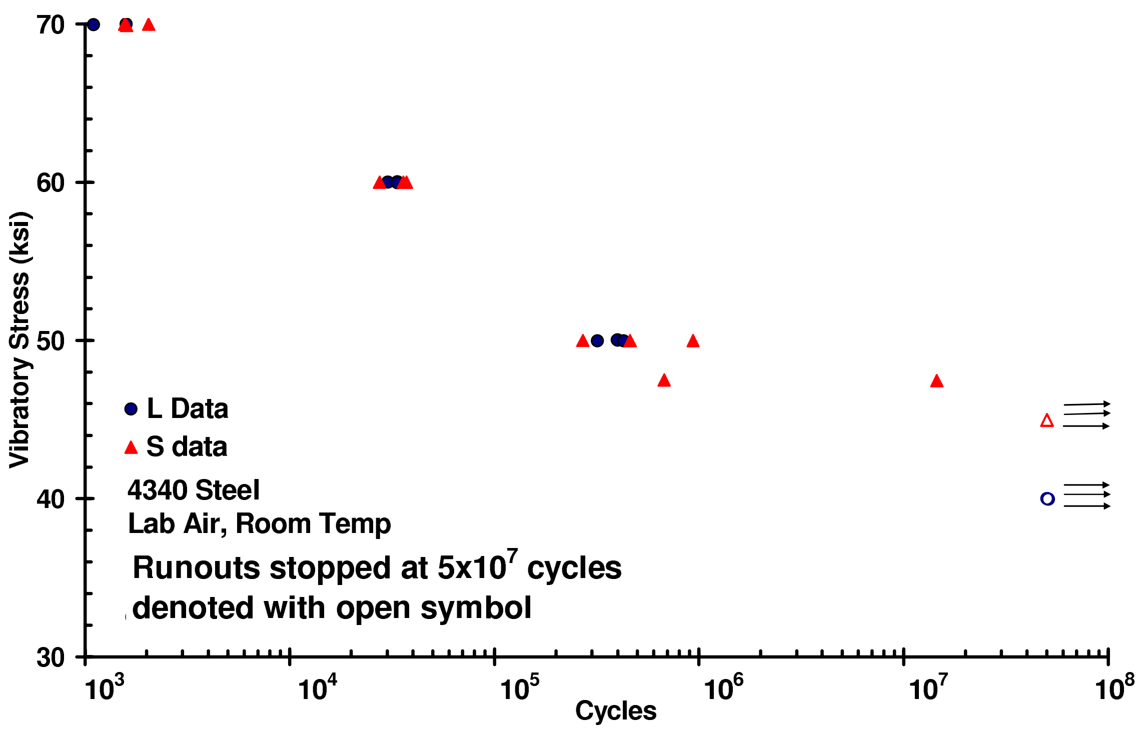


Figure 20: Fatigue (stress-life) data for steel alloy 4340.

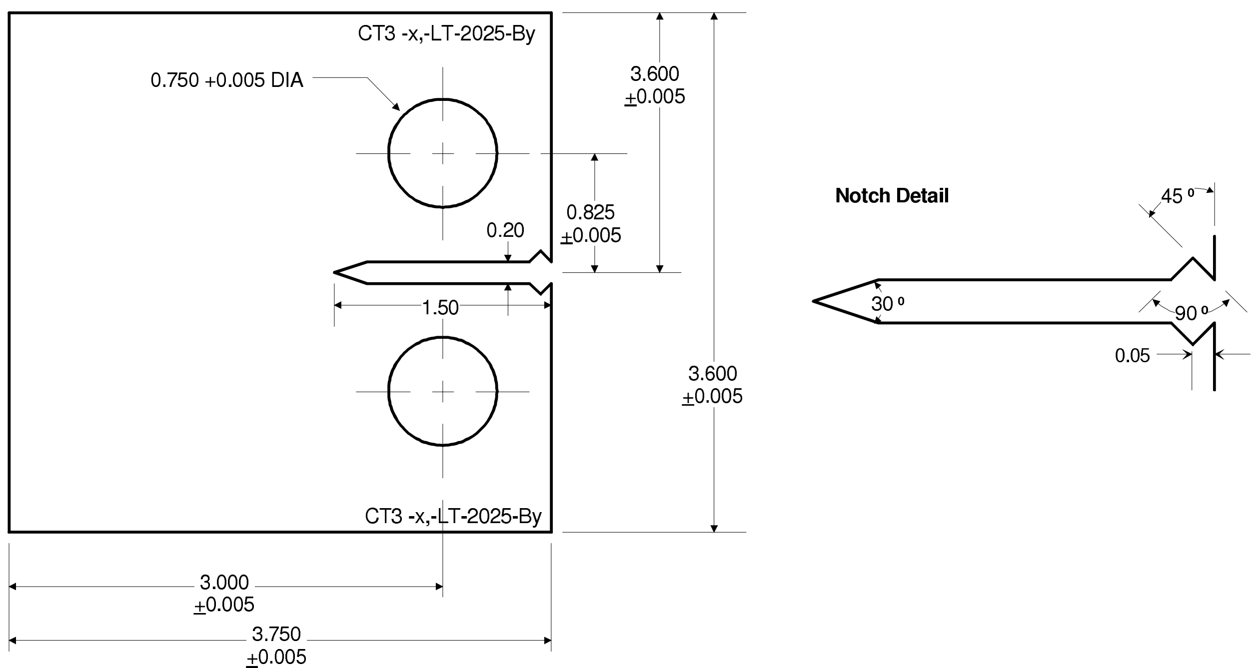


Figure 21: Schematics of the compact tension C(T) specimen (all dimensions are inches or degrees).

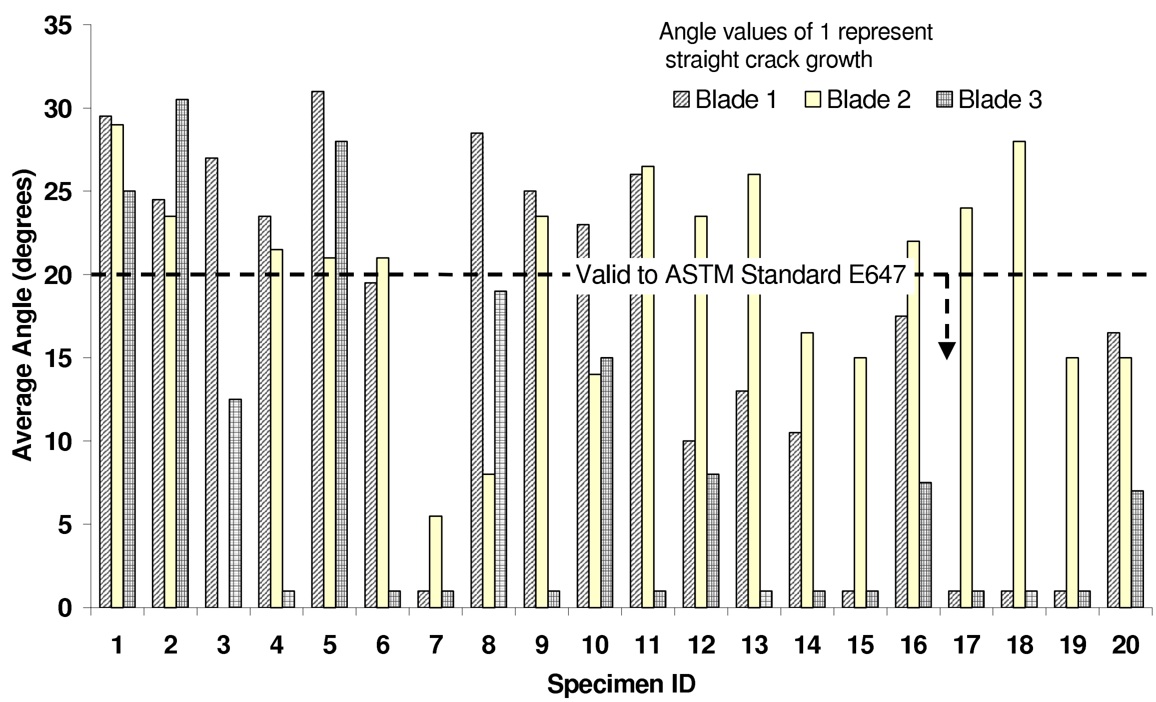


Figure 22: Average angle from centerline for fatigue crack growth tests.

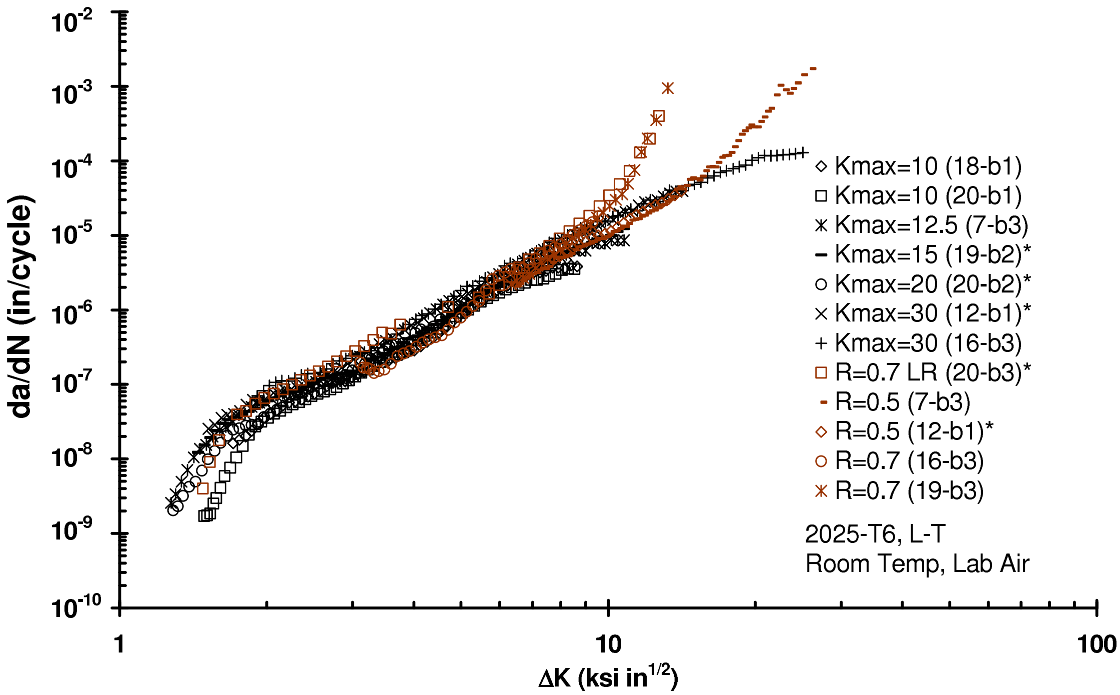


Figure 23: Fatigue crack growth rate data for aluminum alloy 2025-T6 (L-T). An asterisk (*) indicates crack growth out-of-plane between 10 and 20 degrees.

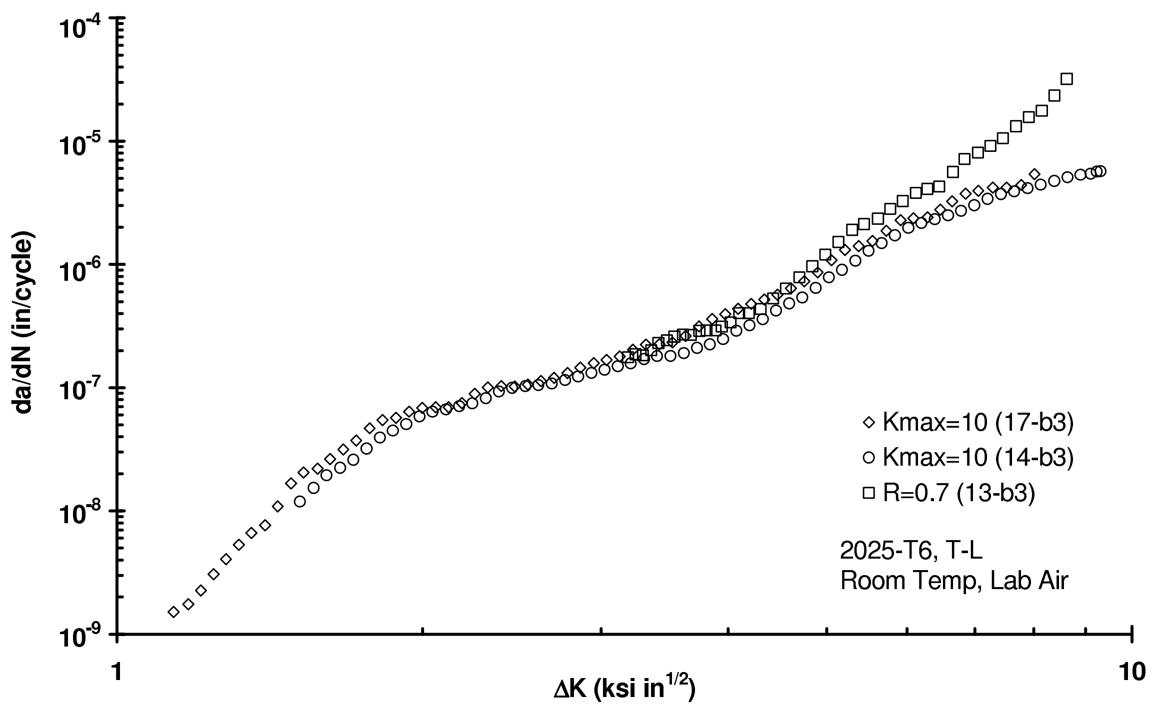


Figure 24: Fatigue-crack-growth-rate data for alloy 2025-T6 (T-L).

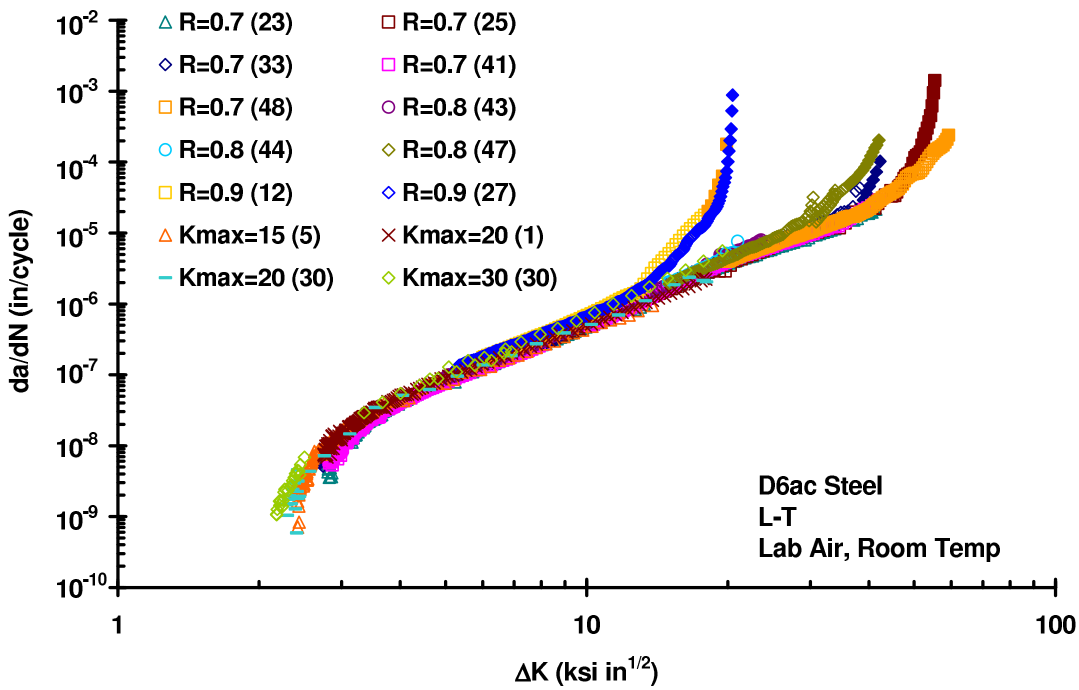


Figure 25: High stress ratio fatigue crack growth rate data for steel alloy D6AC (L-T). Filled symbols do not meet ASTM E647.

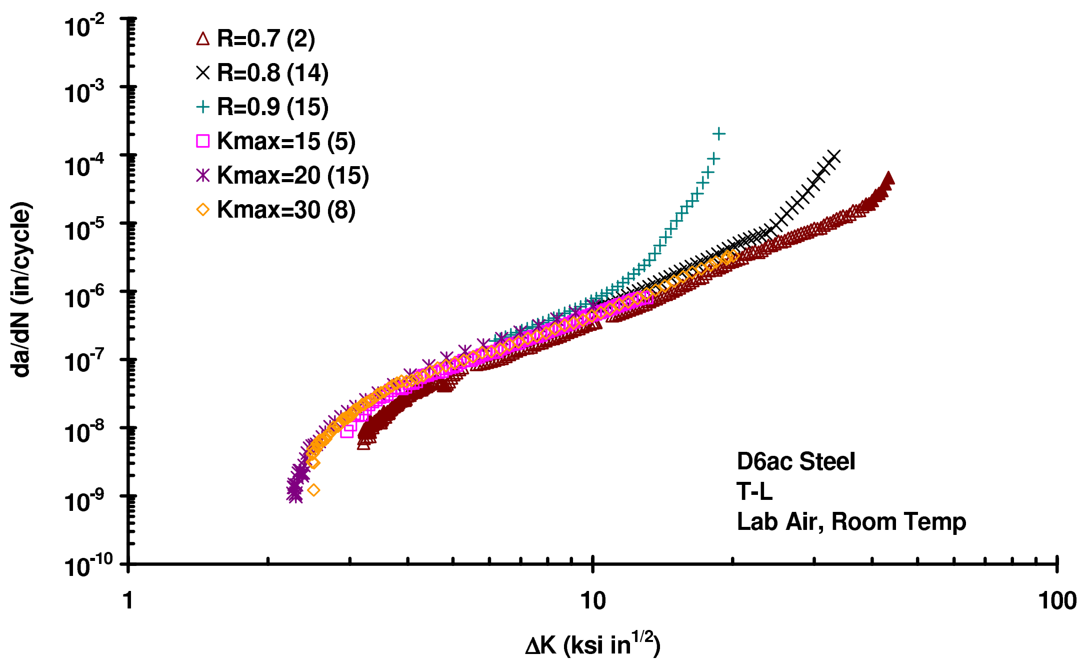


Figure 26: High stress ratio fatigue-crack-growth-rate data for steel alloy D6AC (T-L). Filled symbols do not meet ASTM E647.

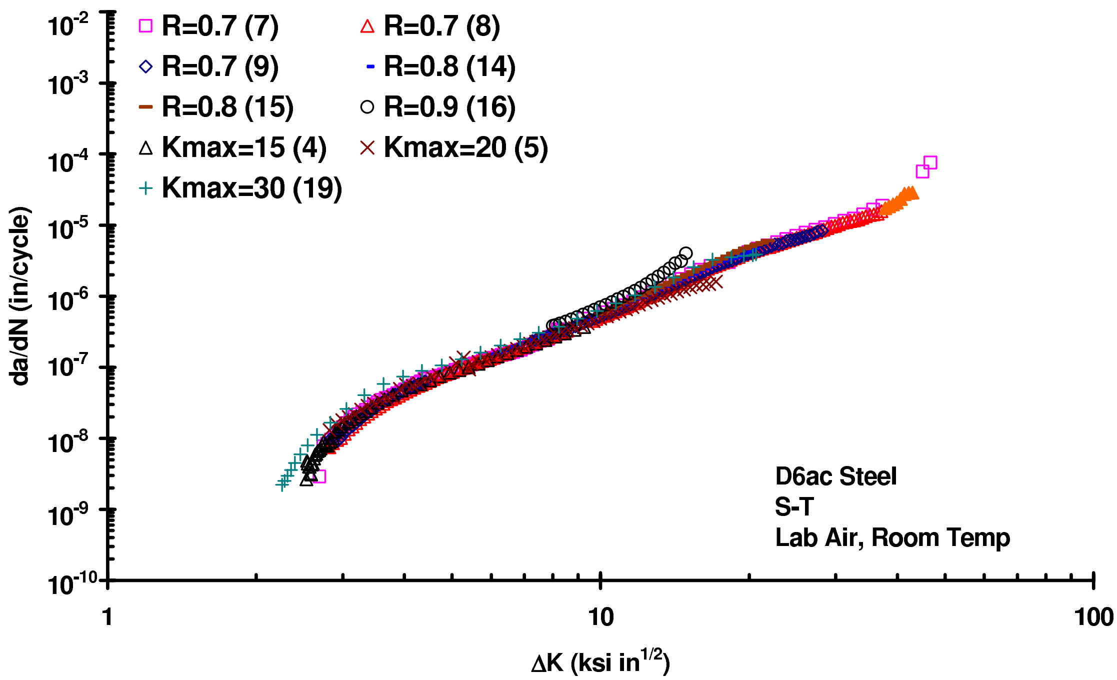


Figure 27: High stress ratio fatigue-crack-growth-rate data for steel alloy D6AC (S-T). Filled symbols do not meet ASTM E647.

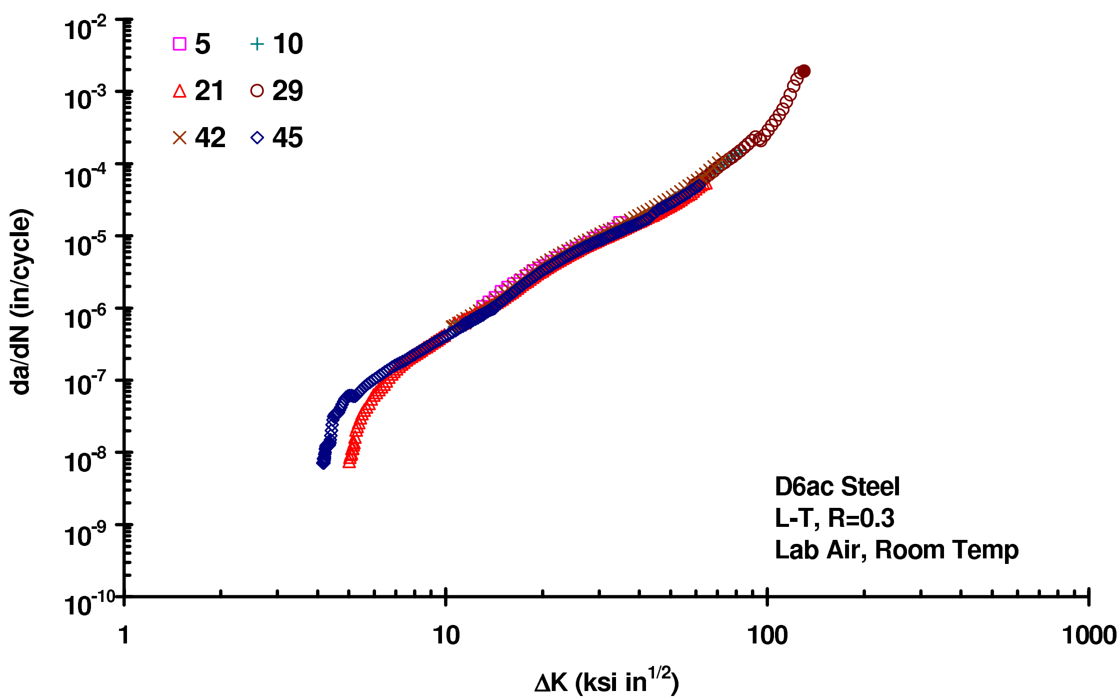


Figure 28: R = 0.3 fatigue-crack-growth-rate data for steel alloy D6AC (L-T). Filled symbols do not meet ASTM E647.

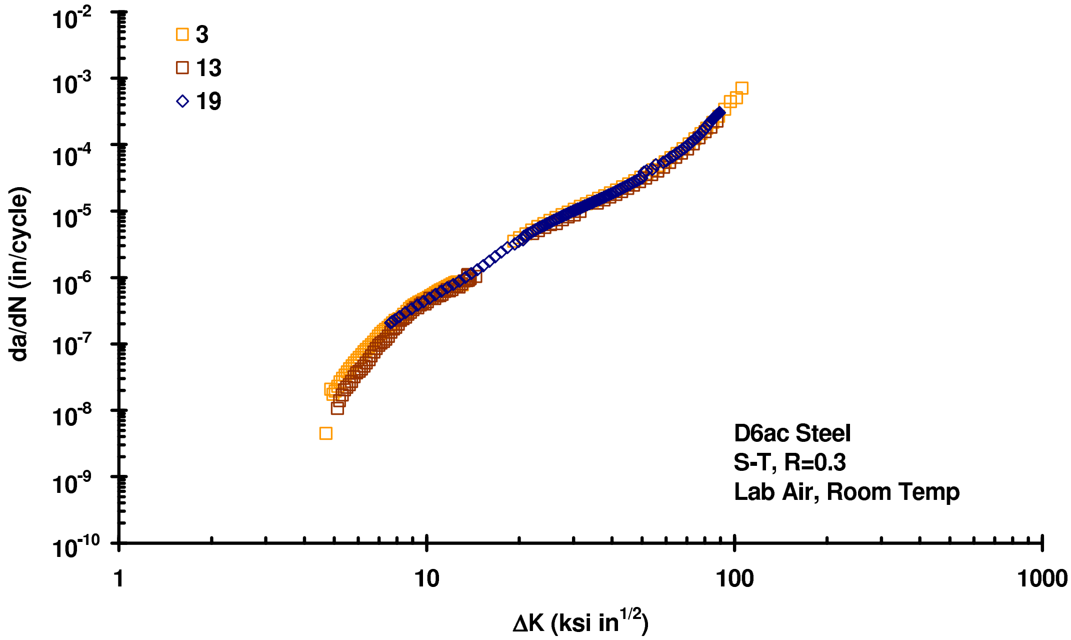


Figure 29: R = 0.3 fatigue-crack-growth-rate data for steel alloy D6AC (S-T). Filled symbols do not meet ASTM E647.

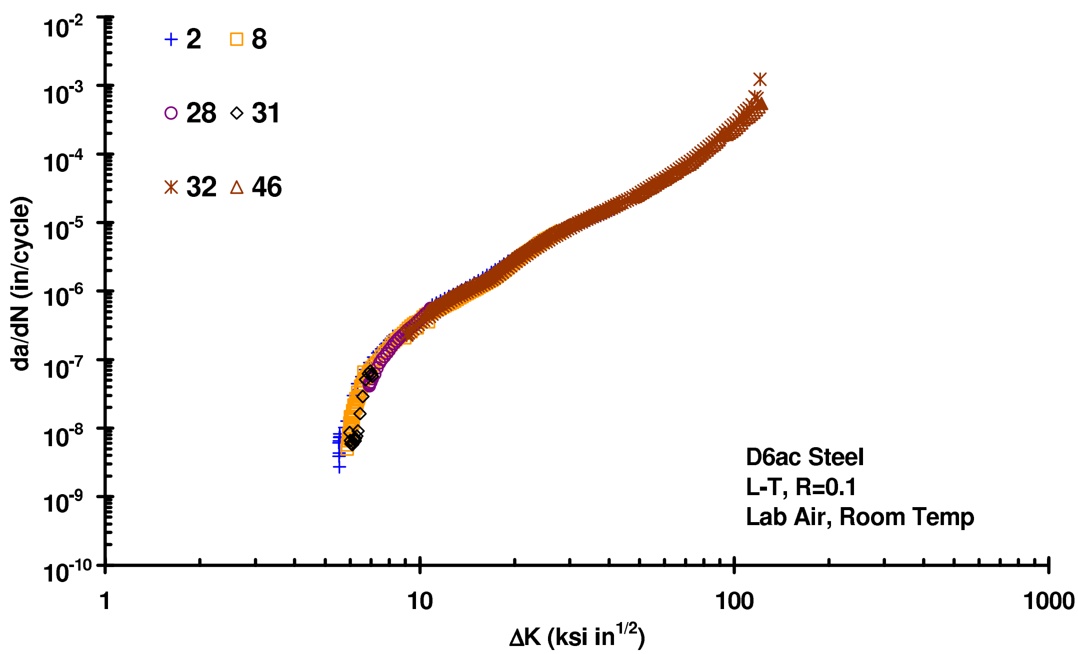


Figure 30: R = 0.1 fatigue-crack-growth-rate data for steel alloy D6AC (L-T). Filled symbols do not meet ASTM E647.

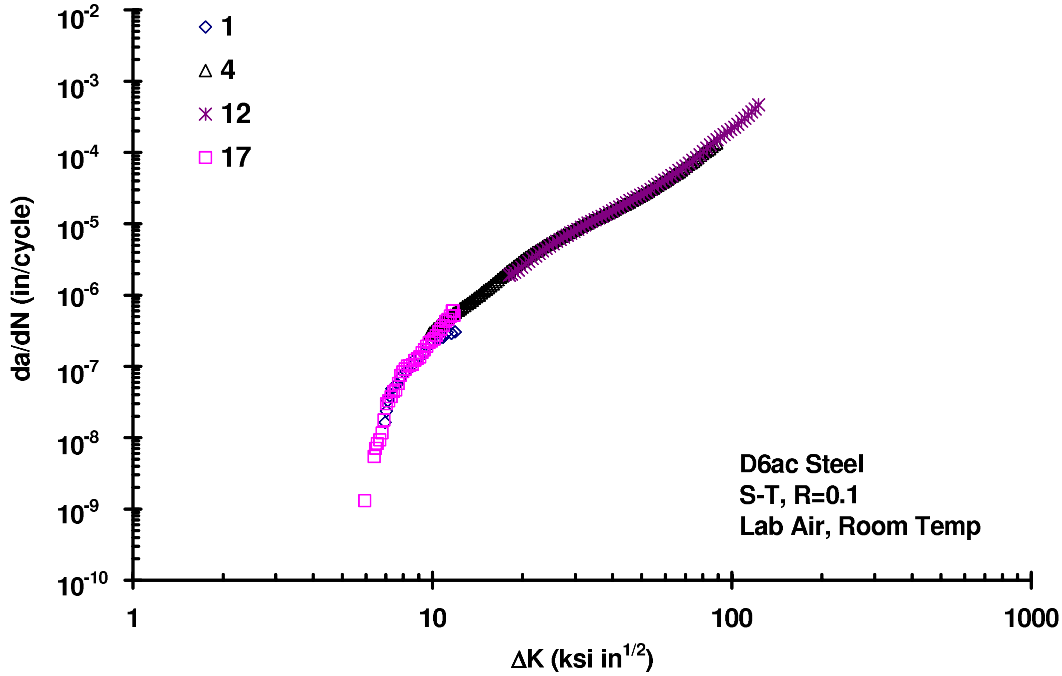


Figure 31: R = 0.1 fatigue-crack-growth-rate data for steel alloy D6AC (S-T). Filled symbols do not meet ASTM E647.

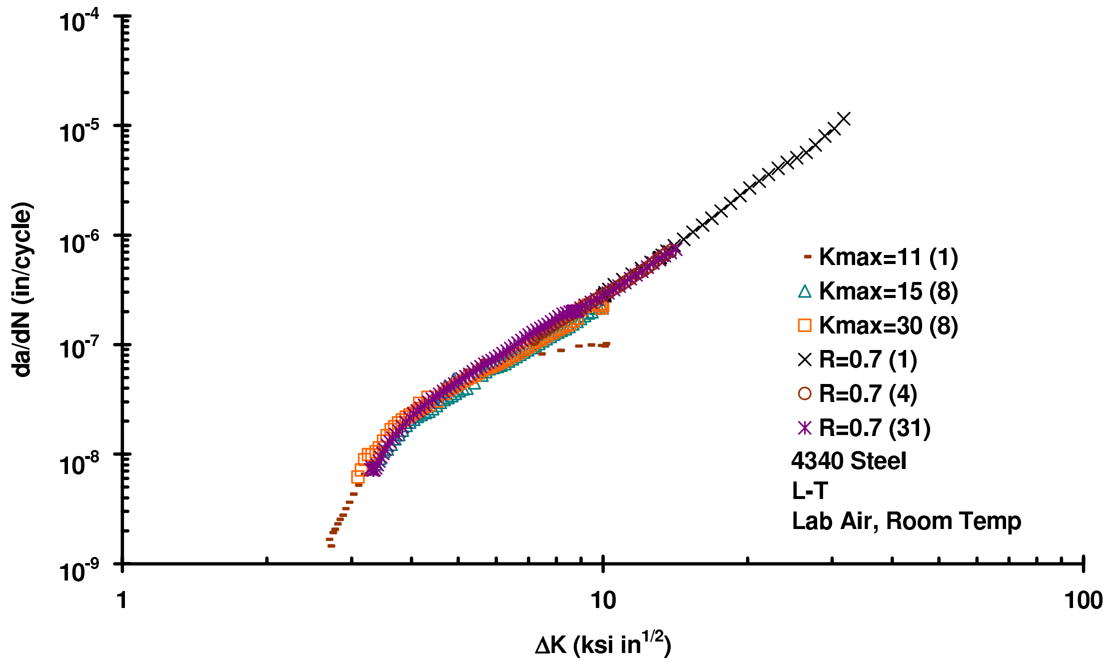


Figure 32: High stress ratio fatigue crack growth rate data for steel alloy 4340 (L-T).

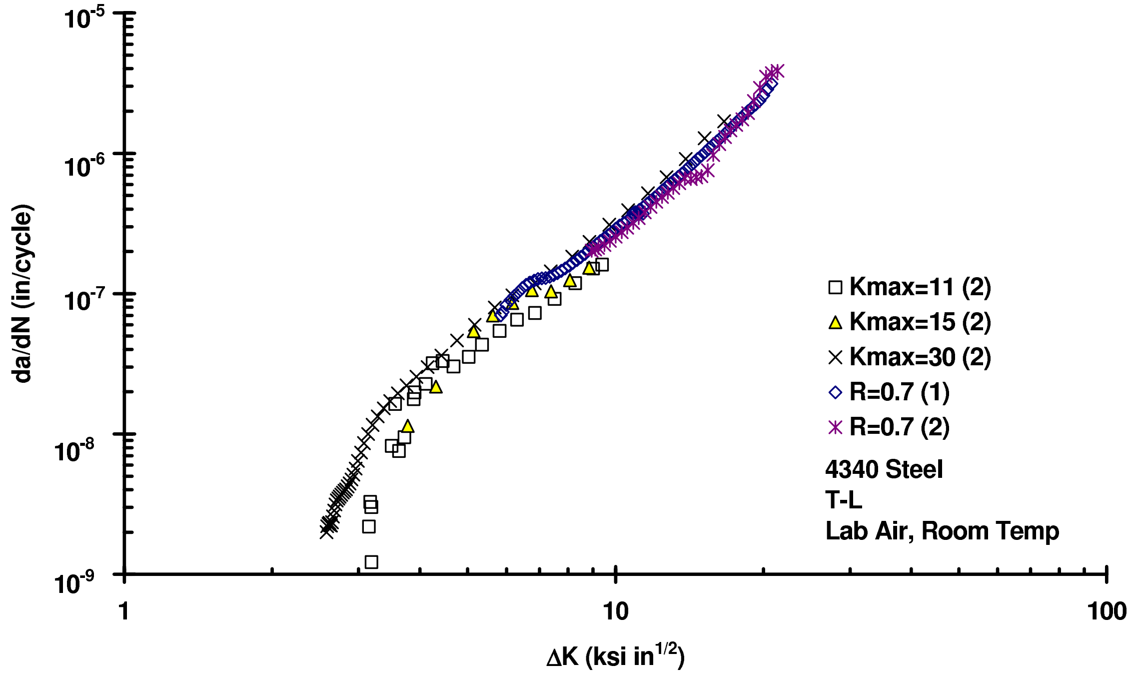


Figure 33: High stress ratio fatigue-crack-growth-rate data for steel alloy 4340 (T-L).

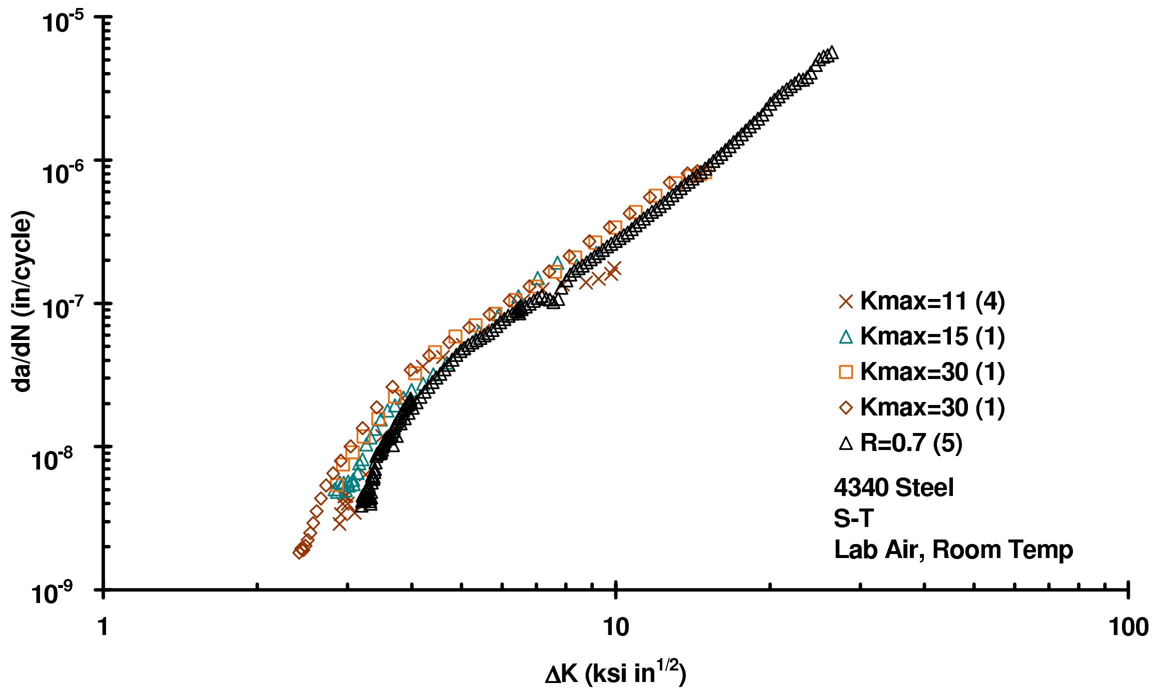


Figure 34: High stress ratio fatigue-crack-growth-rate data for steel alloy 4340 (S-T).

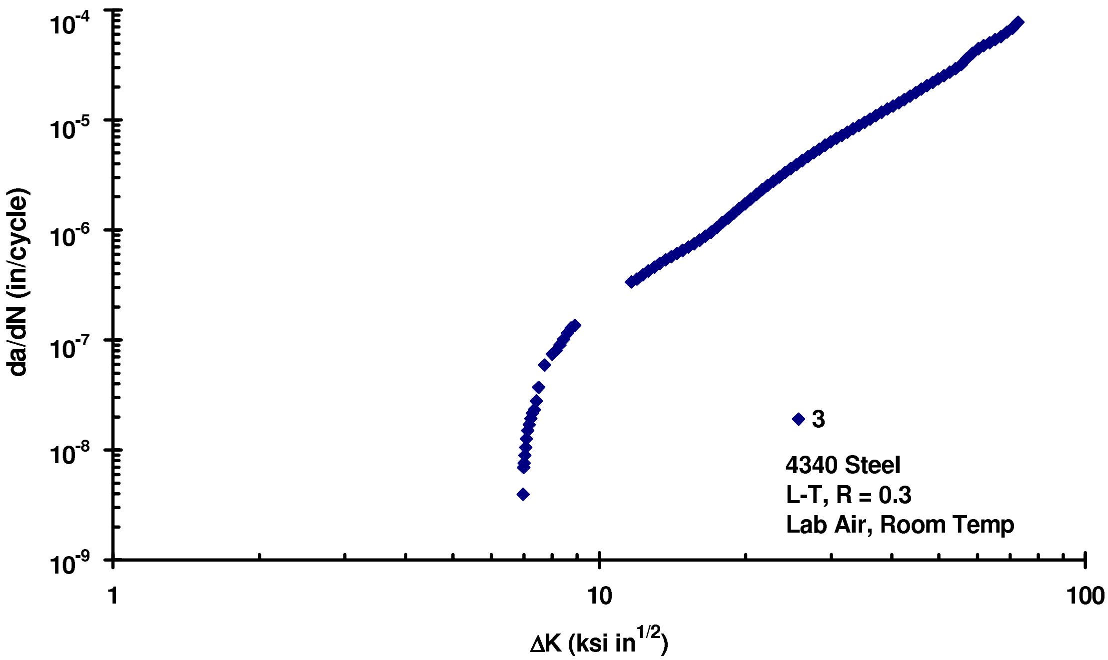


Figure 35: $R = 0.3$ fatigue-crack-growth-rate data for steel alloy 4340 (L-T).

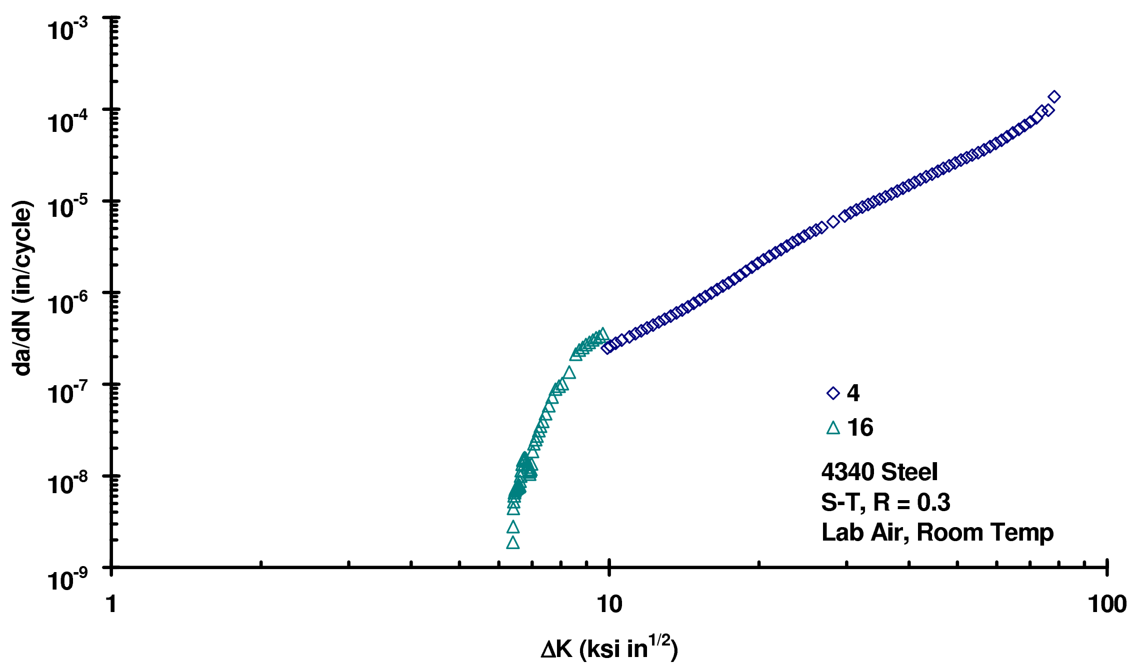


Figure 36: $R = 0.3$ fatigue-crack-growth-rate data for steel alloy 4340 (S-T).

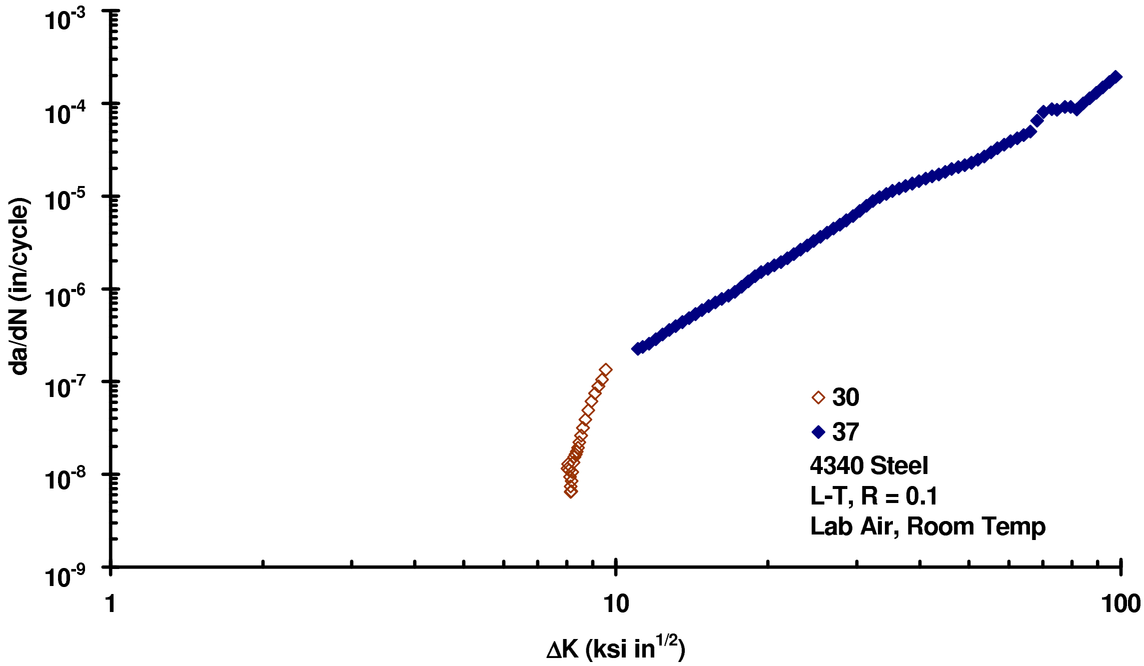


Figure 37: $R = 0.1$ fatigue-crack-growth-rate data for steel alloy 4340 (L-T).

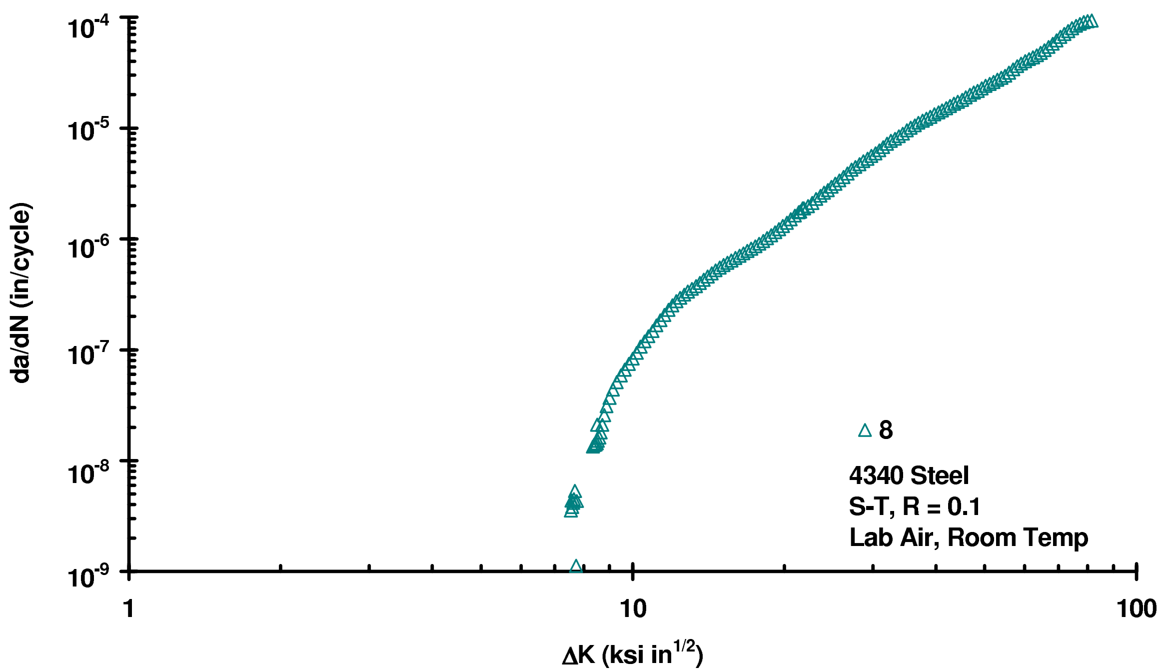


Figure 38: $R = 0.1$ fatigue-crack-growth-rate data for steel alloy 4340 (S-T).

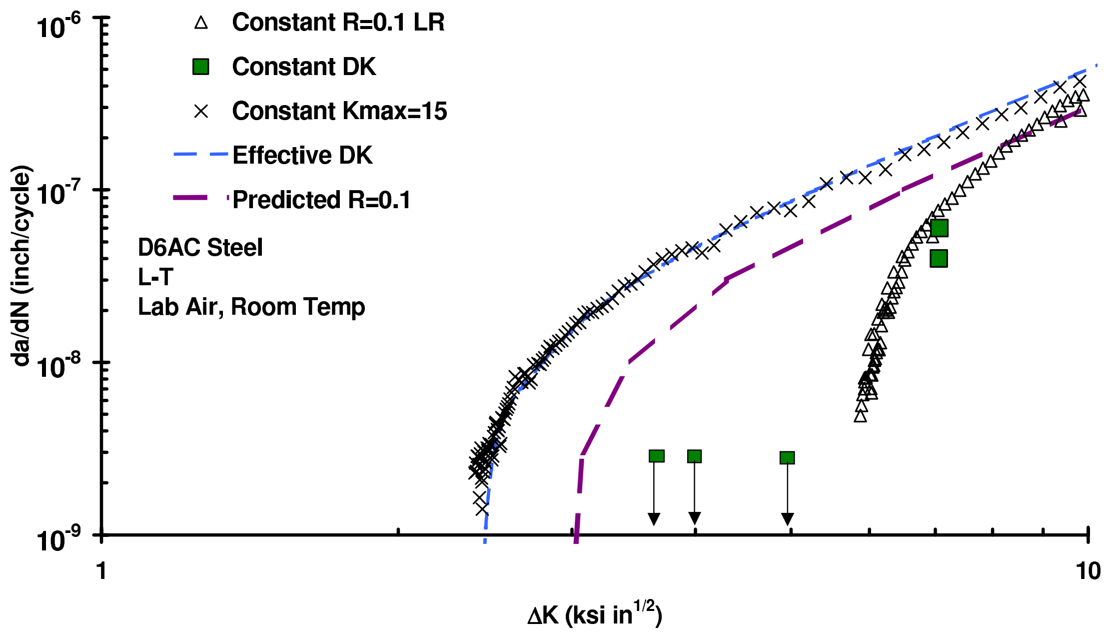


Figure 39: Effective stress intensity curves for steel alloy D6AC (L-T).

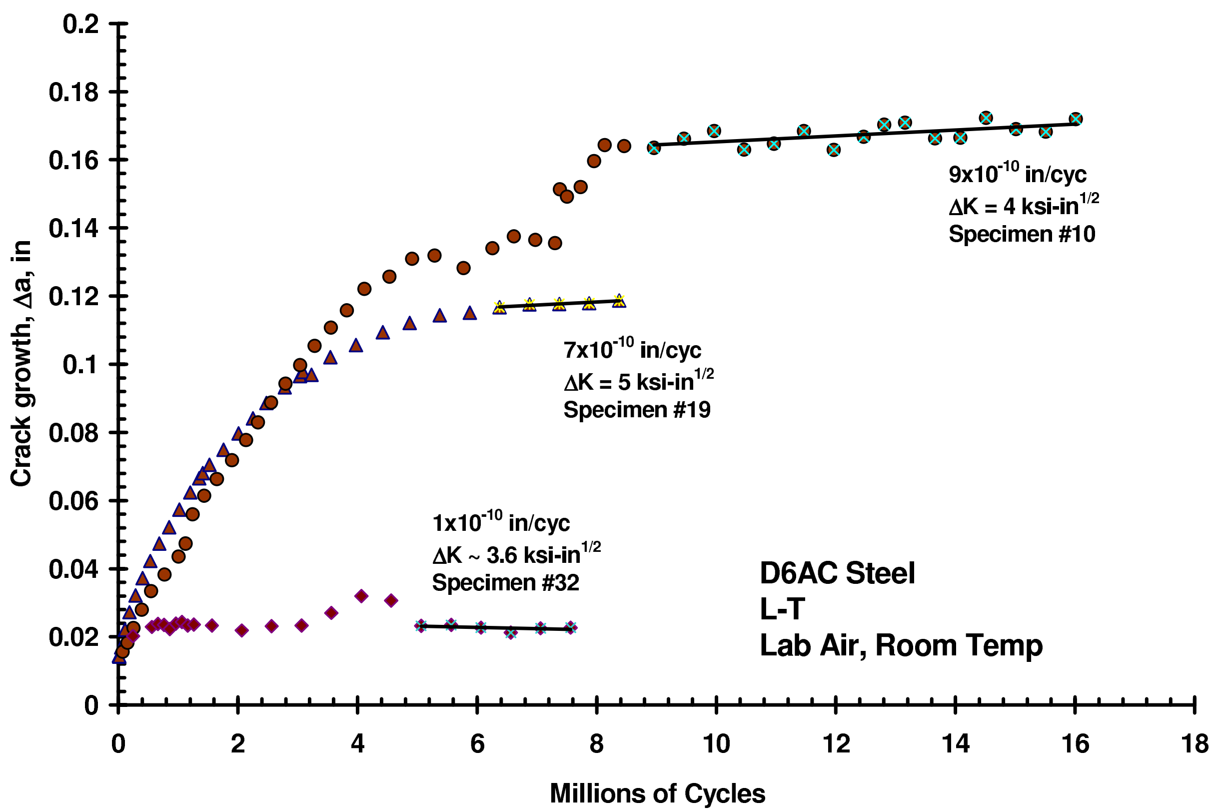


Figure 40: $R = 0.1$ fatigue-crack-growth-rate data for steel alloy D6AC (L-T).

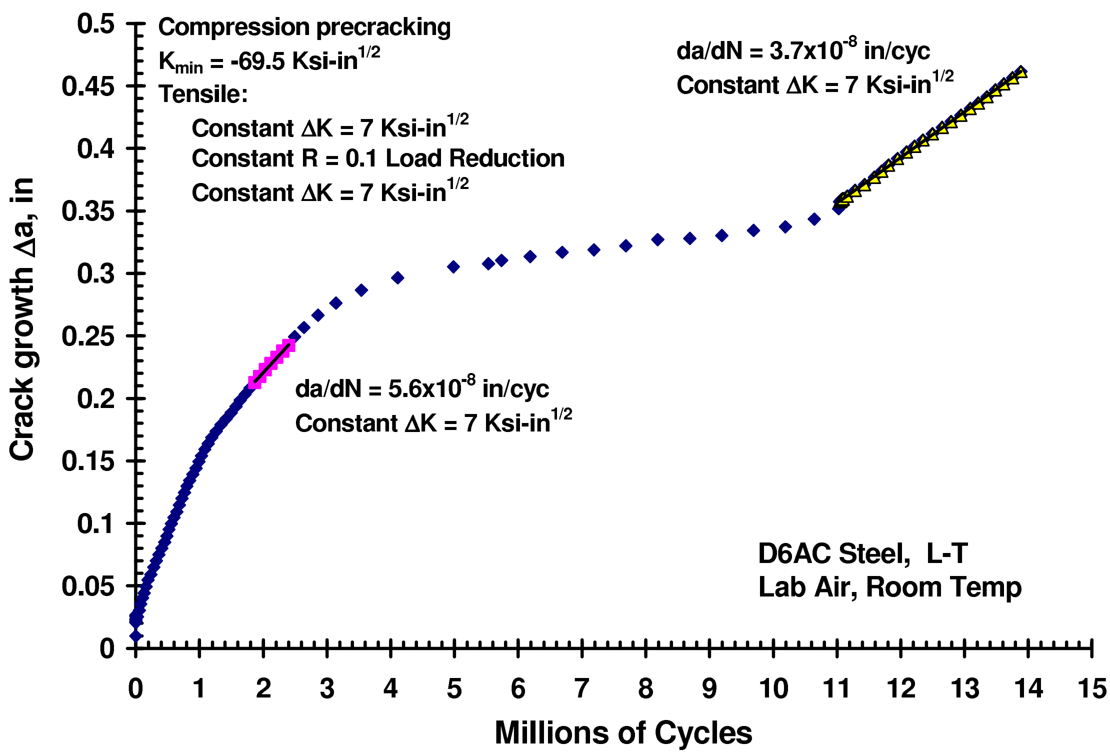


Figure 41: Fatigue crack growth rate data for specimen number 31 of steel alloy D6AC (L-T).

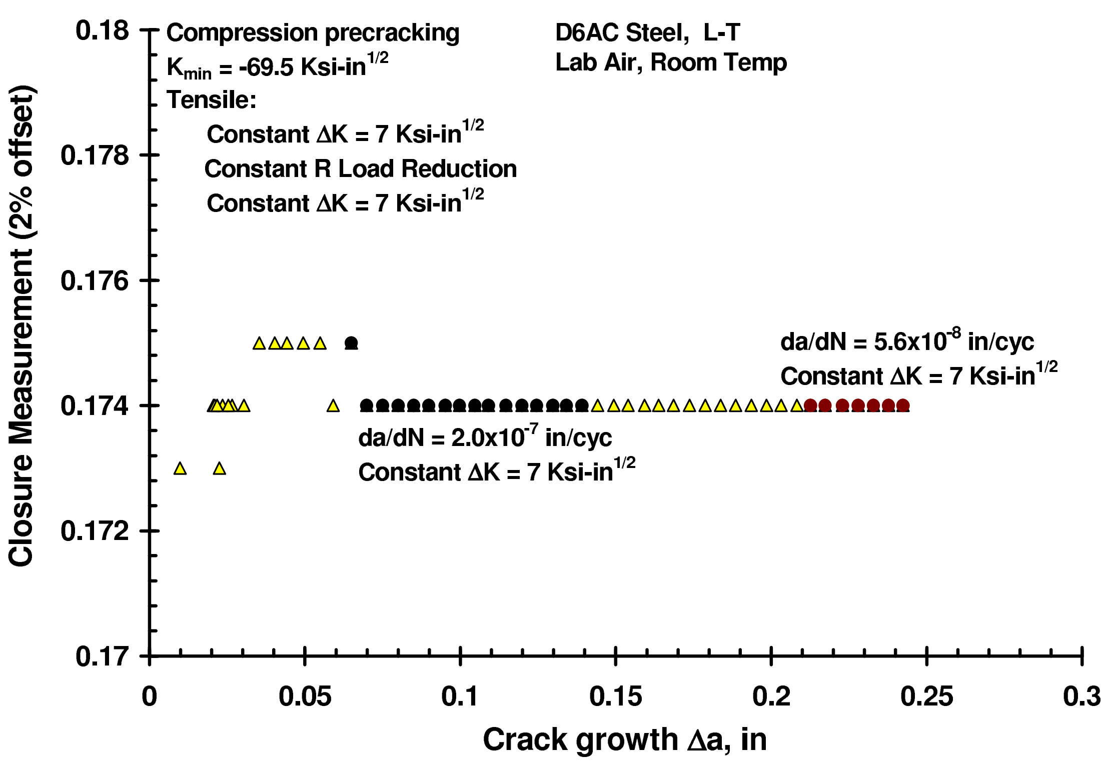


Figure 42: Crack closure measurements versus crack growth data for specimen number 31 of steel alloy D6AC (L-T).

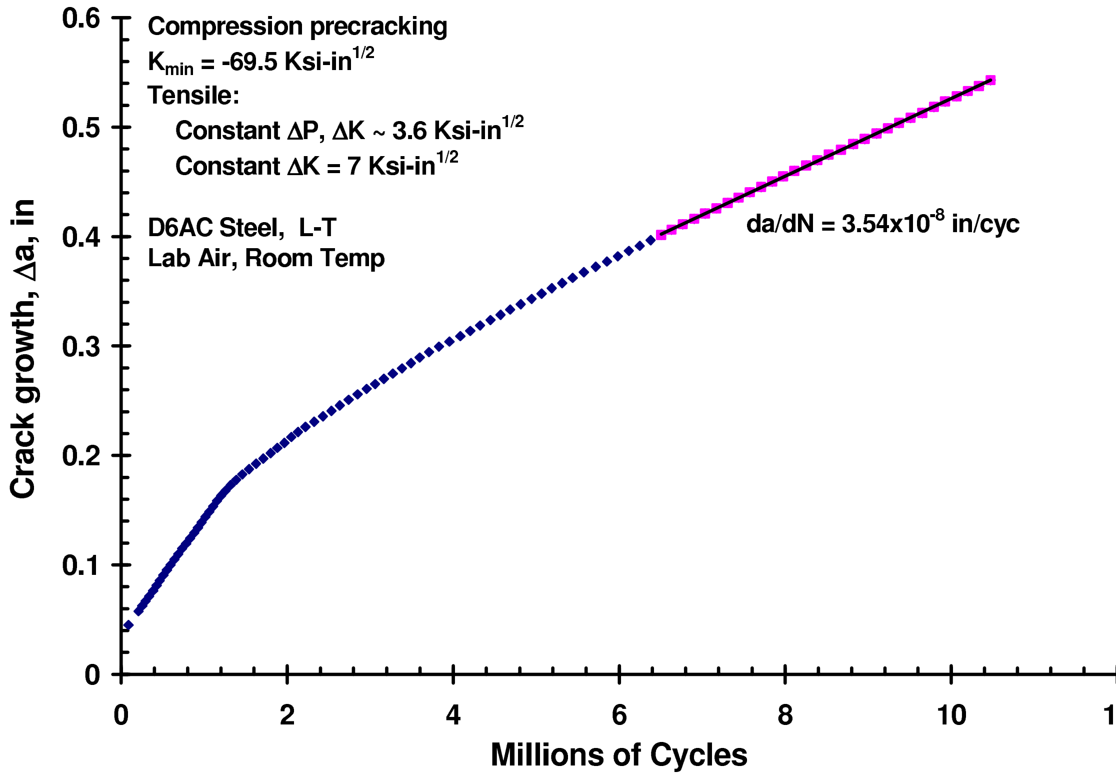


Figure 43: Fatigue-crack-growth-rate data for specimen number 32 of steel alloy D6AC (L-T).

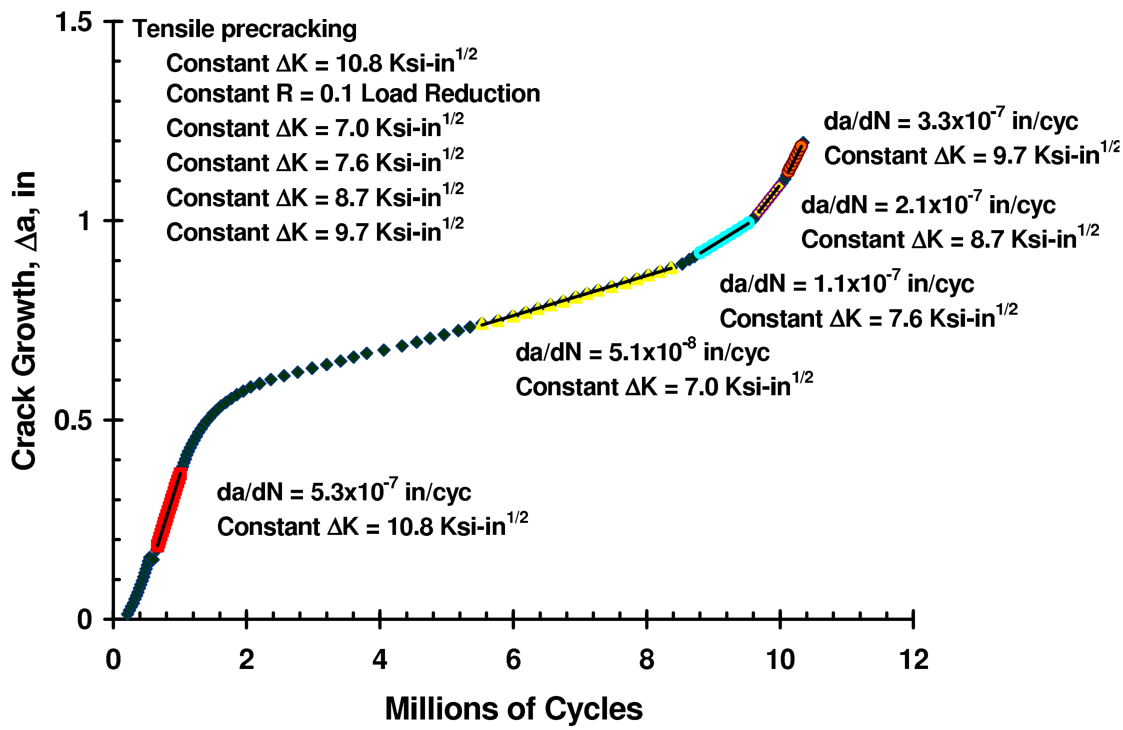


Figure 44: Fatigue-crack-growth-rate data for Specimen number 28 of steel alloy D6AC (L-T).

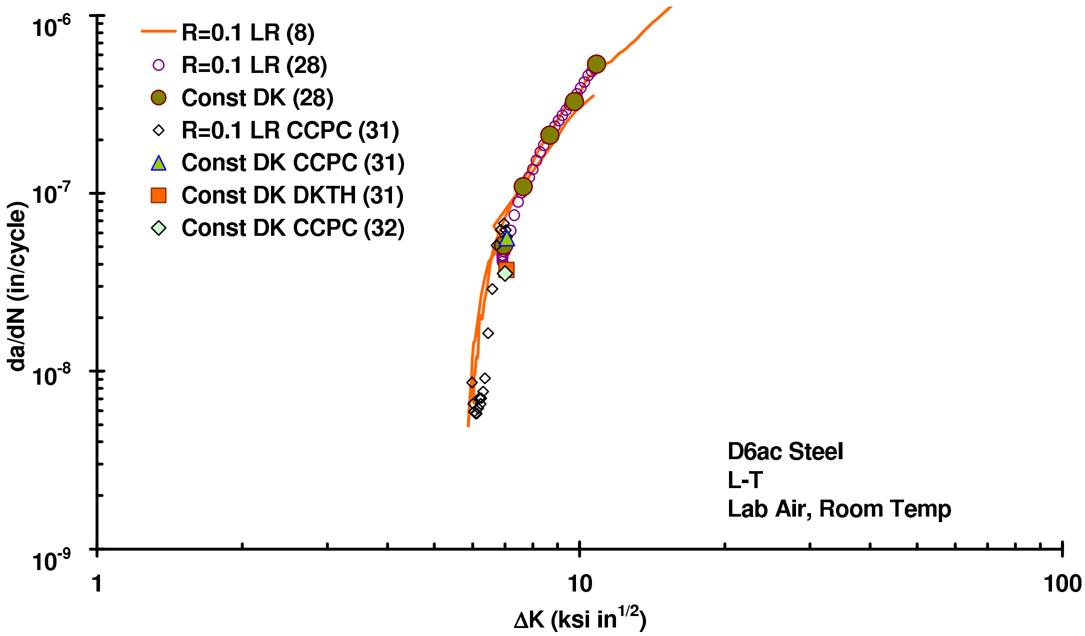


Figure 45: $R = 0.1$ constant ΔK fatigue-crack-growth-rate data for steel alloy D6AC (L-T).

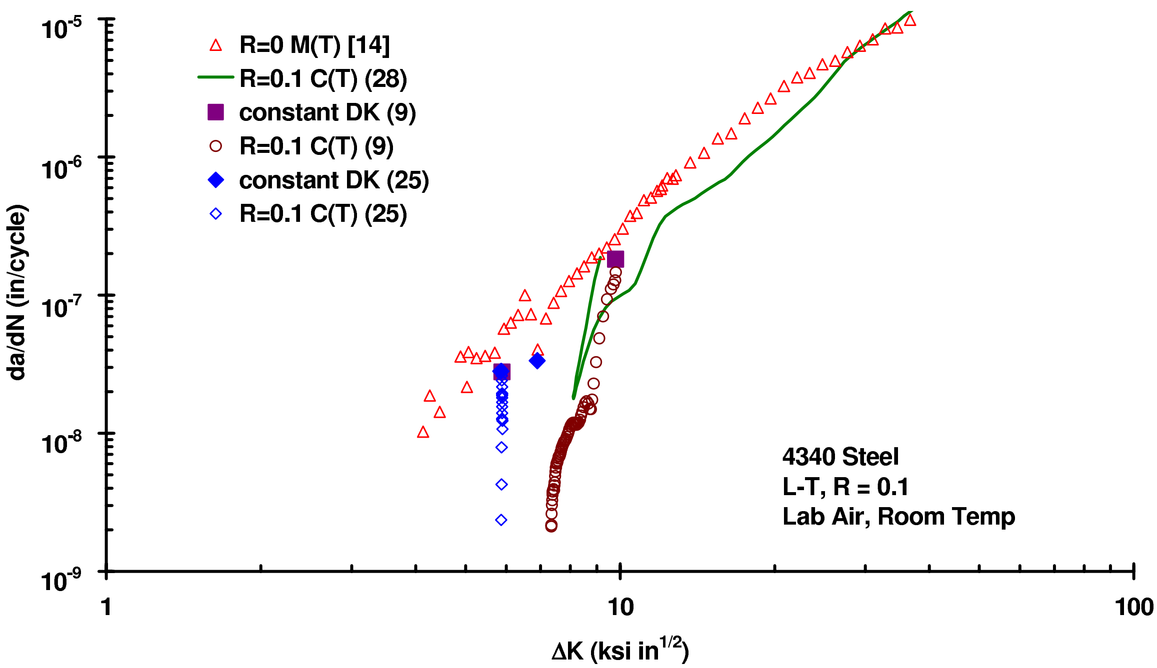


Figure 46: Comparison of fatigue-crack-growth-rate data for steel alloy 4340 (L-T).

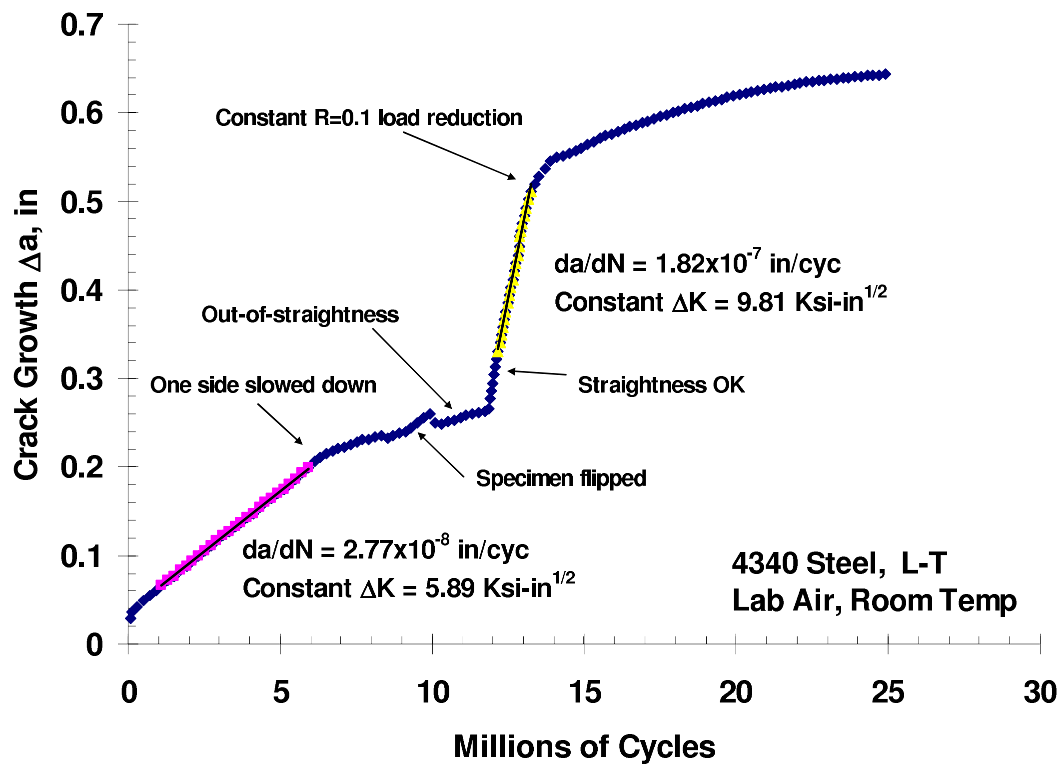


Figure 47: Fatigue crack growth rate data for specimen number 9 of steel alloy 4340 (L-T).

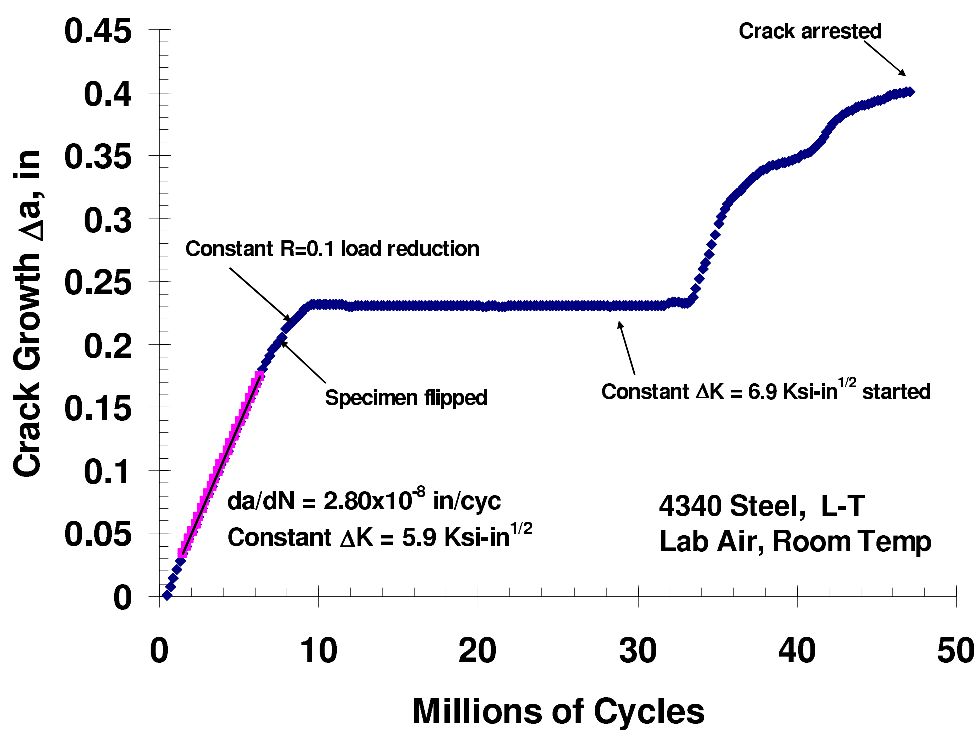


Figure 48: Fatigue crack growth rate data for specimen number 25 of steel alloy 4340 (L-T).

APPENDIX A

The fatigue crack growth rate data (d*a*/dN and ΔK) for 2025-T6 aluminum alloy are listed in Tables A1 through A15 of this appendix in the order it appears in Figures 13 and 14.

Table A1. Constant-K_{max} FCG data for specimen 18-b1 of 2025-T6 Al.

Specimen ID:	18-b1			Orientation:	L-T
Test:	K_{max} = 10 ksi $in^{1/2}$			Out-of-plane Angle:	< 5
ΔK ($ksi\ in^{1/2}$)	da/dN (inch/cycle)	ΔK ($ksi\ in^{1/2}$)	da/dN (inch/cycle)	ΔK ($ksi\ in^{1/2}$)	da/dN (inch/cycle)
8.63	3.82E-06	4.93	7.98E-07	2.81	1.15E-07
8.39	3.96E-06	4.79	6.88E-07	2.73	1.05E-07
8.16	3.63E-06	4.65	5.68E-07	2.65	9.43E-08
7.90	3.69E-06	4.51	4.90E-07	2.58	8.40E-08
7.70	3.67E-06	4.38	4.26E-07	2.50	7.50E-08
7.46	3.34E-06	4.25	3.71E-07	2.43	6.84E-08
7.25	3.17E-06	4.13	3.24E-07	2.36	6.25E-08
7.03	3.13E-06	4.01	2.85E-07	2.29	5.91E-08
6.83	2.91E-06	3.89	2.67E-07	2.22	5.70E-08
6.61	2.66E-06	3.78	2.47E-07	2.16	5.23E-08
6.43	2.54E-06	3.67	2.24E-07	2.10	4.48E-08
6.24	2.15E-06	3.56	2.09E-07	2.04	4.00E-08
6.06	1.91E-06	3.46	1.94E-07	1.98	3.59E-08
5.89	1.75E-06	3.36	1.79E-07	1.92	2.96E-08
5.72	1.56E-06	3.26	1.59E-07	1.86	2.38E-08
5.55	1.34E-06	3.17	1.45E-07	1.81	2.00E-08
5.39	1.17E-06	3.08	1.36E-07	1.76	1.81E-08
5.23	1.03E-06	2.98	1.24E-07	1.71	1.62E-08
5.07	8.98E-07	2.90	1.20E-07		

Table A2. Constant-K_{max} FCG data for specimen 20-b1 of 2025-T6 Al.

Specimen ID:	20-b1			Orientation:	L-T
Test:	K_{max} = 10 ksi $in^{1/2}$			Out-of-plane Angle:	< 5
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
8.53	3.51E-06	4.59	6.27E-07	2.47	6.92E-08
8.28	3.57E-06	4.46	5.57E-07	2.40	6.31E-08
8.04	3.42E-06	4.33	4.89E-07	2.33	5.77E-08
7.81	3.03E-06	4.20	4.48E-07	2.26	5.36E-08
7.57	2.83E-06	4.08	3.92E-07	2.19	4.90E-08
7.37	2.61E-06	3.96	3.38E-07	2.13	4.42E-08
7.15	2.52E-06	3.85	3.01E-07	2.07	4.04E-08
6.96	2.53E-06	3.74	2.74E-07	2.01	3.55E-08
6.76	2.31E-06	3.63	2.53E-07	1.95	3.17E-08
6.56	2.14E-06	3.52	2.27E-07	1.90	2.73E-08
6.36	2.01E-06	3.42	1.98E-07	1.84	2.10E-08
6.17	1.87E-06	3.32	1.75E-07	1.79	1.49E-08
5.98	1.70E-06	3.22	1.58E-07	1.73	1.04E-08
5.81	1.56E-06	3.13	1.43E-07	1.68	7.62E-09
5.65	1.43E-06	3.04	1.27E-07	1.64	5.92E-09
5.49	1.28E-06	2.95	1.13E-07	1.61	4.09E-09
5.33	1.14E-06	2.86	1.02E-07	1.58	2.97E-09
5.17	1.01E-06	2.78	9.19E-08	1.56	2.52E-09
5.02	9.09E-07	2.70	8.60E-08	1.53	1.85E-09
4.87	8.18E-07	2.62	8.03E-08	1.51	1.74E-09
4.73	7.01E-07	2.55	7.45E-08	1.49	1.71E-09

Table A3. Constant-K_{max} FCG data for specimen 7-b3 of 2025-T6 Al.

Specimen ID:	7-b3			Orientation:	L-T
Test:	K_{max} = 12.5 ksi in$^{1/2}$			Out-of-plane Angle:	< 5
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
10.77	8.58E-06	5.12	1.07E-06	2.43	9.76E-08
10.45	8.52E-06	4.98	1.09E-06	2.37	8.21E-08
10.15	8.65E-06	4.82	9.29E-07	2.29	7.71E-08
9.85	7.72E-06	4.68	7.72E-07	2.23	8.02E-08
9.53	7.80E-06	4.55	6.06E-07	2.15	7.63E-08
9.28	7.92E-06	4.41	5.43E-07	2.09	7.12E-08
8.99	6.18E-06	4.28	5.01E-07	2.03	6.84E-08
8.72	6.21E-06	4.15	4.17E-07	1.97	6.12E-08
8.48	6.33E-06	4.03	3.79E-07	1.91	5.71E-08
8.21	5.48E-06	3.92	3.21E-07	1.86	4.99E-08
7.98	5.10E-06	3.80	2.97E-07	1.81	4.05E-08
7.75	4.88E-06	3.70	2.87E-07	1.75	3.86E-08
7.53	4.53E-06	3.58	2.57E-07	1.70	3.17E-08
7.32	4.03E-06	3.48	2.39E-07	1.65	2.67E-08
7.11	3.59E-06	3.37	2.15E-07	1.60	2.43E-08
6.89	3.21E-06	3.28	1.83E-07	1.55	1.99E-08
6.68	3.15E-06	3.18	1.59E-07	1.50	1.54E-08
6.50	2.69E-06	3.09	1.51E-07	1.46	1.36E-08
6.29	2.39E-06	3.00	1.32E-07	1.42	1.05E-08
6.13	2.43E-06	2.91	1.16E-07	1.38	7.10E-09
5.95	1.99E-06	2.83	1.10E-07	1.34	4.96E-09
5.77	1.84E-06	2.74	1.06E-07	1.30	3.38E-09
5.60	1.75E-06	2.64	1.31E-07	1.27	2.57E-09
5.43	1.60E-06	2.58	1.26E-07		
5.29	1.25E-06	2.49	9.38E-08		

Table A4. Constant-K_{max} FCG data for specimen 19-b2 of 2025-T6 Al.

Specimen ID:	19-b2			Orientation:	L-T
Test:	K_{max} = 15 ksi $in^{1/2}$			Out-of-plane Angle:	15
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
12.86	1.29E-05	6.11	2.43E-06	2.88	1.42E-07
12.52	1.20E-05	5.92	2.08E-06	2.80	1.38E-07
12.13	1.18E-05	5.75	1.98E-06	2.71	1.28E-07
11.79	1.23E-05	5.58	1.81E-06	2.63	1.23E-07
11.44	1.16E-05	5.42	1.56E-06	2.55	1.16E-07
11.08	1.16E-05	5.25	1.34E-06	2.48	1.03E-07
10.77	1.22E-05	5.10	1.16E-06	2.41	9.26E-08
10.45	1.12E-05	4.95	1.00E-06	2.34	8.51E-08
10.14	9.90E-06	4.80	8.80E-07	2.27	8.00E-08
9.86	9.44E-06	4.66	7.92E-07	2.20	7.76E-08
9.56	8.74E-06	4.52	7.08E-07	2.14	7.13E-08
9.28	8.03E-06	4.39	6.29E-07	2.07	6.55E-08
9.00	7.46E-06	4.26	5.54E-07	2.01	6.00E-08
8.73	6.88E-06	4.13	4.94E-07	1.95	5.29E-08
8.48	6.31E-06	4.01	4.36E-07	1.89	4.73E-08
8.23	6.03E-06	3.88	4.07E-07	1.84	4.34E-08
8.00	5.63E-06	3.78	3.64E-07	1.78	4.01E-08
7.75	5.25E-06	3.66	3.12E-07	1.73	3.65E-08
7.53	4.80E-06	3.56	2.93E-07	1.68	3.35E-08
7.30	4.27E-06	3.45	2.59E-07	1.63	2.99E-08
7.09	3.88E-06	3.35	2.33E-07	1.58	2.38E-08
6.88	3.57E-06	3.25	2.19E-07	1.53	1.92E-08
6.69	3.14E-06	3.14	2.66E-07	1.49	1.54E-08
6.49	2.74E-06	3.06	2.46E-07	1.45	1.22E-08
6.29	2.72E-06	2.96	1.51E-07		

Table A5. Constant-K_{max} FCG data for specimen 20-b2 of 2025-T6 Al.

Specimen ID:	20-b2			Orientation:	L-T
Test:	K_{max} = 20.0 ksi $in^{1/2}$			Out-of-plane Angle:	15
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
9.47	1.13E-05	4.82	1.01E-06	2.43	8.75E-08
9.21	1.03E-05	4.66	8.25E-07	2.36	7.72E-08
8.92	9.09E-06	4.53	7.38E-07	2.29	7.21E-08
8.66	8.75E-06	4.39	6.00E-07	2.22	6.79E-08
8.40	7.99E-06	4.26	5.09E-07	2.16	5.87E-08
8.15	7.08E-06	4.14	5.42E-07	2.10	4.54E-08
7.91	6.82E-06	4.03	4.92E-07	2.03	4.07E-08
7.70	6.47E-06	3.91	3.65E-07	1.98	3.62E-08
7.47	5.40E-06	3.80	3.55E-07	1.92	2.93E-08
7.27	4.72E-06	3.69	3.52E-07	1.86	2.87E-08
7.06	4.44E-06	3.57	3.23E-07	1.81	2.80E-08
6.85	4.11E-06	3.47	2.78E-07	1.76	2.58E-08
6.65	3.66E-06	3.37	2.28E-07	1.71	2.45E-08
6.46	3.28E-06	3.27	2.19E-07	1.66	2.04E-08
6.28	2.76E-06	3.18	1.91E-07	1.61	1.65E-08
6.09	2.64E-06	3.08	1.60E-07	1.56	1.28E-08
5.92	2.58E-06	2.99	1.54E-07	1.52	9.88E-09
5.74	2.16E-06	2.90	1.35E-07	1.47	6.96E-09
5.57	1.82E-06	2.82	1.18E-07	1.43	4.95E-09
5.41	1.64E-06	2.74	1.13E-07	1.39	4.23E-09
5.26	1.49E-06	2.65	1.14E-07	1.35	3.18E-09
5.11	1.21E-06	2.58	1.12E-07	1.32	2.32E-09
4.96	1.13E-06	2.50	1.03E-07	1.29	2.03E-09

Table A6. Constant-K_{max} FCG data for specimen 12-b1 of 2025-T6 Al.

Specimen ID:	12-b1			Orientation:	L-T
Test:	K_{max} = 30.0 ksi $in^{1/2}$			Out-of-plane Angle:	10
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
14.19	3.92E-05	6.54	4.08E-06	3.02	2.17E-07
13.79	3.85E-05	6.35	3.54E-06	2.93	1.90E-07
13.39	3.66E-05	6.17	3.22E-06	2.84	1.67E-07
12.99	3.34E-05	5.98	3.03E-06	2.76	1.54E-07
12.62	2.95E-05	5.81	2.72E-06	2.68	1.40E-07
12.25	2.78E-05	5.65	2.37E-06	2.61	1.21E-07
11.89	2.79E-05	5.48	2.11E-06	2.53	1.08E-07
11.54	2.53E-05	5.33	1.86E-06	2.45	1.02E-07
11.20	2.13E-05	5.17	1.66E-06	2.38	9.56E-08
10.86	2.06E-05	5.02	1.51E-06	2.31	8.88E-08
10.55	1.95E-05	4.87	1.41E-06	2.24	8.55E-08
10.24	1.61E-05	4.73	1.32E-06	2.18	8.52E-08
9.93	1.54E-05	4.59	1.18E-06	2.11	7.71E-08
9.66	1.42E-05	4.45	1.02E-06	2.05	6.35E-08
9.36	1.23E-05	4.32	9.05E-07	1.99	5.62E-08
9.09	1.17E-05	4.19	7.73E-07	1.93	5.72E-08
8.82	1.12E-05	4.07	6.75E-07	1.87	6.18E-08
8.56	1.02E-05	3.95	6.16E-07	1.82	5.35E-08
8.30	9.18E-06	3.84	5.35E-07	1.76	4.39E-08
8.07	8.56E-06	3.73	4.69E-07	1.71	4.02E-08
7.84	7.77E-06	3.61	4.25E-07	1.66	3.90E-08
7.60	7.08E-06	3.51	3.83E-07	1.62	3.57E-08
7.38	6.39E-06	3.40	3.47E-07	1.57	2.86E-08
7.16	5.70E-06	3.30	3.13E-07	1.52	2.54E-08
6.95	5.00E-06	3.20	2.67E-07		
6.74	4.56E-06	3.11	2.35E-07		

Table A7. Constant-K_{max} FCG data for specimen 16-b3 of 2025-T6 Al.

Specimen ID:	16-b3			Orientation:	L-T
Test:	K_{max} = 30.0 ksi in$^{1/2}$			Out-of-plane Angle:	7.5
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
25.05	1.29E-04	9.31	1.33E-05	3.47	3.47E-07
24.19	1.25E-04	9.03	1.24E-05	3.37	3.08E-07
23.50	1.22E-04	8.78	1.25E-05	3.27	2.84E-07
22.79	1.20E-04	8.51	1.17E-05	3.17	2.71E-07
22.15	1.18E-04	8.26	1.01E-05	3.08	2.61E-07
21.53	1.17E-04	8.02	9.06E-06	2.99	2.42E-07
20.90	1.18E-04	7.79	9.07E-06	2.90	2.23E-07
20.28	1.10E-04	7.57	8.06E-06	2.82	2.08E-07
19.71	1.01E-04	7.35	6.56E-06	2.73	1.88E-07
19.11	8.79E-05	7.13	6.18E-06	2.65	1.62E-07
18.53	8.32E-05	6.92	5.48E-06	2.57	1.45E-07
18.02	7.83E-05	6.70	4.90E-06	2.50	1.40E-07
17.45	7.36E-05	6.52	4.41E-06	2.43	1.39E-07
16.97	6.98E-05	6.30	4.22E-06	2.35	1.34E-07
16.45	6.27E-05	6.13	3.89E-06	2.28	1.22E-07
15.97	5.88E-05	5.94	3.00E-06	2.22	1.11E-07
15.49	5.16E-05	5.77	2.67E-06	2.15	1.12E-07
15.03	4.85E-05	5.60	2.69E-06	2.09	1.06E-07
14.60	4.66E-05	5.45	2.41E-06	2.02	9.62E-08
14.17	3.97E-05	5.29	2.10E-06	1.97	8.20E-08
13.76	3.90E-05	5.14	2.06E-06	1.91	7.02E-08
13.36	4.03E-05	4.98	1.81E-06	1.86	7.15E-08
12.96	3.26E-05	4.83	1.52E-06	1.80	6.50E-08
12.58	2.83E-05	4.69	1.30E-06	1.75	5.24E-08
12.19	2.98E-05	4.55	1.18E-06	1.69	4.89E-08
11.82	2.65E-05	4.42	1.03E-06	1.65	4.14E-08
11.48	2.13E-05	4.28	8.87E-07	1.59	3.74E-08
11.12	2.24E-05	4.16	8.41E-07	1.55	3.56E-08
10.83	2.02E-05	4.04	7.45E-07	1.51	2.89E-08
10.48	1.84E-05	3.92	6.38E-07	1.46	3.42E-08
10.22	1.78E-05	3.80	5.67E-07	1.42	4.16E-08
9.87	1.56E-05	3.69	4.74E-07	1.38	3.67E-08
9.60	1.52E-05	3.58	3.99E-07	1.34	2.48E-08

Table A8. Constant-R (decreasing then increasing ΔK) FCG data for specimen 20-b3 of 2025-T6 Al.

Specimen ID:	20-b3			Orientation:	L-T
Test:	R = 0.7			Out-of-plane Angle:	7
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
3.75	6.35E-07	2.07	7.51E-08	6.89	4.74E-06
3.60	4.80E-07	1.98	6.57E-08	7.25	5.76E-06
3.45	4.97E-07	1.90	5.48E-08	7.58	7.18E-06
3.31	3.93E-07	1.82	4.39E-08	7.95	9.07E-06
3.17	3.26E-07	1.74	3.95E-08	8.34	1.13E-05
3.04	2.79E-07	1.60	1.77E-08	8.73	1.44E-05
2.91	2.39E-07	1.53	9.12E-09	9.15	1.83E-05
2.79	2.02E-07	1.48	4.03E-09	9.60	2.47E-05
2.67	1.73E-07	4.70	1.09E-06	10.05	3.42E-05
2.56	1.50E-07	5.44	1.47E-06	10.57	4.84E-05
2.45	1.32E-07	5.70	1.65E-06	11.06	7.28E-05
2.35	1.15E-07	5.98	2.15E-06	11.60	1.29E-04
2.25	9.90E-08	6.27	2.77E-06	12.17	1.98E-04
2.16	8.53E-08	6.58	3.72E-06	12.71	3.99E-04

Table A9. Constant-R (increasing ΔK) FCG data for specimen 12-b1 of 2025-T6 Al.

Specimen ID:	12-b1			Orientation:	L-T
Test:	R = 0.5			Out-of-plane Angle:	10
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
7.75	4.81E-06	9.55	1.00E-05	11.78	2.08E-05
7.96	5.26E-06	9.84	1.04E-05	12.14	2.31E-05
8.22	5.90E-06	10.14	1.14E-05	12.51	2.54E-05
8.47	6.69E-06	10.45	1.29E-05	12.89	2.73E-05
8.73	7.38E-06	10.77	1.46E-05	13.28	3.07E-05
9.00	8.27E-06	11.10	1.67E-05	13.69	3.45E-05
9.26	9.35E-06	11.43	1.89E-05	14.12	3.91E-05

Table A10. Constant-R (increasing ΔK) FCG data for specimen 7-b3 of 2025-T6 Al.

Specimen ID:	7-b3			Orientation:	L-T
Test:	R = 0.5			Out-of-plane Angle:	< 5
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
6.45	2.08E-06	10.16	1.11E-05	15.94	8.24E-05
6.55	2.24E-06	10.31	1.16E-05	16.16	8.38E-05
6.64	2.46E-06	10.47	1.23E-05	16.42	8.25E-05
6.75	2.66E-06	10.62	1.32E-05	16.67	9.46E-05
6.85	2.83E-06	10.77	1.31E-05	16.93	1.11E-04
6.96	3.06E-06	10.93	1.44E-05	17.19	1.17E-04
7.06	3.16E-06	11.09	1.60E-05	17.45	1.17E-04
7.17	3.43E-06	11.26	1.64E-05	17.71	1.29E-04
7.28	3.61E-06	11.43	1.67E-05	17.99	1.54E-04
7.39	3.55E-06	11.61	1.81E-05	18.28	1.86E-04
7.51	3.83E-06	11.77	1.86E-05	18.59	2.26E-04
7.62	4.35E-06	11.97	1.98E-05	18.86	2.52E-04
7.74	4.93E-06	12.14	2.13E-05	19.17	2.76E-04
7.85	5.08E-06	12.33	2.18E-05	19.44	3.01E-04
7.97	5.07E-06	12.52	2.33E-05	19.71	2.85E-04
8.09	5.13E-06	12.71	2.52E-05	20.04	2.85E-04
8.21	5.30E-06	12.89	2.59E-05	20.36	3.37E-04
8.34	5.70E-06	13.10	2.85E-05	20.68	3.88E-04
8.47	6.38E-06	13.29	3.05E-05	21.04	4.63E-04
8.60	6.98E-06	13.50	3.28E-05	21.36	5.06E-04
8.73	7.09E-06	13.70	4.19E-05	21.92	7.61E-04
8.86	7.43E-06	13.91	4.45E-05	22.30	1.03E-03
8.99	7.62E-06	14.12	4.19E-05	22.88	8.96E-04
9.13	7.88E-06	14.34	4.65E-05	23.29	8.01E-04
9.26	8.24E-06	14.56	5.59E-05	23.70	9.27E-04
9.40	8.68E-06	14.78	5.93E-05	24.20	1.11E-03
9.54	9.00E-06	15.00	5.72E-05	24.94	1.43E-03
9.69	9.08E-06	15.23	5.52E-05	25.94	1.71E-03
9.85	9.61E-06	15.46	6.18E-05		
10.00	1.04E-05	15.70	7.34E-05		

Table A11. Constant-R (increasing ΔK) FCG data for specimen 16-b3 of 2025-T6 Al..

Specimen ID:	16-b3			Orientation:	L-T
Test:	R = 0.7			Out-of-plane Angle:	7.5
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
3.11	1.96E-07	4.43	4.29E-07	6.70	3.59E-06
3.16	1.68E-07	4.56	4.56E-07	6.90	4.25E-06
3.21	1.66E-07	4.71	5.39E-07	7.11	4.88E-06
3.25	1.60E-07	4.85	6.72E-07	7.33	5.53E-06
3.32	1.42E-07	4.99	7.87E-07	7.55	6.19E-06
3.39	1.50E-07	5.14	9.42E-07	7.77	6.84E-06
3.48	1.58E-07	5.29	1.13E-06	8.00	7.52E-06
3.59	1.88E-07	5.45	1.32E-06	8.25	8.70E-06
3.70	2.38E-07	5.62	1.82E-06	8.48	1.02E-05
3.81	2.60E-07	5.79	2.57E-06	8.74	1.16E-05
3.93	2.80E-07	5.96	2.87E-06	9.00	1.31E-05
4.05	3.18E-07	6.15	3.16E-06	9.28	1.49E-05
4.17	3.63E-07	6.32	3.53E-06	9.56	1.81E-05
4.30	4.02E-07	6.50	3.48E-06		

Table A12. Constant-R (increasing ΔK) FCG data for specimen 19-b3 of 2025-T6 Al..

Specimen ID:	19-b3			Orientation:	L-T
Test:	R = 0.7			Out-of-plane Angle:	< 5
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
6.33	2.19E-06	8.21	7.75E-06	10.68	3.56E-05
6.50	2.45E-06	8.45	9.15E-06	10.97	4.91E-05
6.69	2.69E-06	8.71	1.06E-05	11.32	7.51E-05
6.89	3.03E-06	8.96	1.20E-05	11.69	1.32E-04
7.10	3.64E-06	9.22	1.38E-05	12.03	2.00E-04
7.31	4.31E-06	9.50	1.72E-05	12.54	3.52E-04
7.52	4.78E-06	9.78	2.02E-05	13.24	9.46E-04
7.75	5.44E-06	10.07	2.48E-05		
7.98	6.51E-06	10.36	2.99E-05		

Table A13. Constant-K_{max} FCG data for specimen 17-b3 of 2025-T6 Al..

Specimen ID:	17-b3			Orientation:	T-L
Test:	K_{max} = 10 ksi in$^{1/2}$			Out-of-plane Angle:	< 5
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
8.64	8.03E-06	4.34	5.19E-07	2.19	7.51E-08
8.46	5.79E-06	4.21	4.79E-07	2.12	6.94E-08
8.16	3.96E-06	4.09	4.36E-07	2.06	6.93E-08
8.02	5.41E-06	3.97	3.96E-07	2.00	6.85E-08
7.78	4.42E-06	3.86	3.61E-07	1.94	6.39E-08
7.52	4.20E-06	3.74	3.14E-07	1.88	5.69E-08
7.29	4.21E-06	3.63	2.62E-07	1.83	5.45E-08
7.05	3.96E-06	3.52	2.32E-07	1.77	4.69E-08
6.85	3.75E-06	3.42	2.26E-07	1.72	3.73E-08
6.65	3.25E-06	3.32	2.24E-07	1.67	3.15E-08
6.47	2.78E-06	3.22	2.04E-07	1.62	2.64E-08
6.29	2.41E-06	3.13	1.79E-07	1.58	2.21E-08
6.09	2.37E-06	3.04	1.68E-07	1.53	2.05E-08
5.91	2.29E-06	2.95	1.58E-07	1.48	1.67E-08
5.73	1.87E-06	2.86	1.46E-07	1.44	1.09E-08
5.55	1.55E-06	2.78	1.31E-07	1.40	7.67E-09
5.38	1.41E-06	2.69	1.20E-07	1.36	6.62E-09
5.21	1.31E-06	2.62	1.13E-07	1.32	5.32E-09
5.06	1.08E-06	2.54	1.06E-07	1.28	4.06E-09
4.90	8.61E-07	2.47	1.02E-07	1.24	3.08E-09
4.75	7.31E-07	2.39	1.03E-07	1.21	2.26E-09
4.61	6.39E-07	2.32	1.01E-07	1.18	1.75E-09
4.47	5.68E-07	2.25	8.92E-08	1.14	1.51E-09

Table A14. Constant-K_{max} FCG data for specimen 14-b3 of 2025-T6 Al..

Specimen ID:	14-b3			Orientation:	T-L
Test:	K_{max} = 10 ksi $in^{1/2}$			Out-of-plane Angle:	< 5
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
9.31	5.71E-06	5.03	7.86E-07	2.60	1.05E-07
9.23	5.66E-06	4.88	6.44E-07	2.53	1.03E-07
9.11	5.46E-06	4.73	5.39E-07	2.45	9.95E-08
8.90	5.33E-06	4.60	4.83E-07	2.38	9.33E-08
8.64	5.09E-06	4.46	4.22E-07	2.31	8.22E-08
8.38	4.75E-06	4.33	3.59E-07	2.24	7.46E-08
8.13	4.44E-06	4.20	3.21E-07	2.17	7.07E-08
7.89	4.16E-06	4.08	2.90E-07	2.11	6.66E-08
7.65	3.91E-06	3.96	2.48E-07	2.05	6.39E-08
7.43	3.72E-06	3.84	2.25E-07	1.99	5.85E-08
7.21	3.40E-06	3.73	2.10E-07	1.93	5.07E-08
6.99	3.02E-06	3.62	1.91E-07	1.87	4.49E-08
6.79	2.72E-06	3.51	1.81E-07	1.82	3.95E-08
6.59	2.50E-06	3.41	1.80E-07	1.76	3.21E-08
6.39	2.32E-06	3.31	1.71E-07	1.71	2.61E-08
6.20	2.17E-06	3.21	1.57E-07	1.66	2.24E-08
6.02	1.98E-06	3.11	1.49E-07	1.61	1.95E-08
5.84	1.72E-06	3.02	1.40E-07	1.56	1.54E-08
5.67	1.49E-06	2.93	1.32E-07	1.51	1.19E-08
5.50	1.29E-06	2.85	1.23E-07	1.44	7.07E-09
5.34	1.07E-06	2.76	1.15E-07		
5.18	9.04E-07	2.68	1.08E-07		

Table A15. Constant-R (increasing ΔK) FCG data for specimen 13-b3 of 2025-T6 Al..

Specimen ID:	13-b3			Orientation:	T-L
Test:	R = 0.7			Out-of-plane Angle:	< 5
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
3.19	1.77E-07	4.10	4.02E-07	6.12	3.80E-06
3.24	1.87E-07	4.19	4.03E-07	6.29	4.09E-06
3.30	1.83E-07	4.31	4.35E-07	6.46	4.28E-06
3.36	2.01E-07	4.43	5.30E-07	6.66	5.62E-06
3.42	2.30E-07	4.56	6.38E-07	6.84	7.15E-06
3.48	2.43E-07	4.70	7.87E-07	7.05	8.10E-06
3.54	2.59E-07	4.84	9.66E-07	7.26	9.15E-06
3.61	2.70E-07	4.99	1.20E-06	7.46	1.05E-05
3.68	2.68E-07	5.14	1.52E-06	7.69	1.32E-05
3.75	2.88E-07	5.30	1.91E-06	7.91	1.57E-05
3.81	2.91E-07	5.45	2.12E-06	8.15	1.76E-05
3.89	2.91E-07	5.62	2.35E-06	8.39	2.34E-05
3.94	3.13E-07	5.78	2.82E-06	8.62	3.19E-05
4.02	3.38E-07	5.95	3.27E-06		

APPENDIX B

The fatigue crack growth rate data (d*a*/dN and ΔK) for D6AC steel alloy are listed in Tables B1 through B48 of this appendix sequentially by specimen orientation and number. Italicized data does not meet the ASTM E647 requirement for remaining ligament length.

Table B1. Constant-K_{max} FCG data for specimen 1 - L-T of D6AC Steel.

Specimen ID:	1			Orientation:	L-T
Test:	K_{max} = 20 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
17.96	2.22E-06	4.52	7.07E-08	3.11	1.86E-08
17.70	2.27E-06	4.46	6.69E-08	3.10	1.82E-08
17.56	2.12E-06	4.40	6.39E-08	3.09	1.64E-08
17.04	1.91E-06	4.34	6.19E-08	3.08	1.64E-08
16.54	1.76E-06	4.29	5.48E-08	3.07	1.66E-08
16.05	1.64E-06	4.24	5.35E-08	3.06	1.64E-08
15.57	1.51E-06	4.20	5.65E-08	3.05	1.55E-08
15.11	1.40E-06	4.15	5.34E-08	3.04	1.48E-08
14.66	1.30E-06	4.10	5.25E-08	3.03	1.50E-08
14.23	1.20E-06	4.06	5.19E-08	3.02	1.50E-08
13.81	1.12E-06	4.02	5.13E-08	3.01	1.47E-08
13.40	1.04E-06	3.98	4.96E-08	3.00	1.38E-08
13.00	9.61E-07	3.94	4.68E-08	3.00	1.21E-08
12.62	8.85E-07	3.90	4.47E-08	2.99	1.30E-08
12.25	8.17E-07	3.87	4.34E-08	2.98	1.54E-08
11.89	7.57E-07	3.83	4.21E-08	2.97	1.59E-08
11.53	7.02E-07	3.80	4.06E-08	2.96	1.36E-08
11.19	6.52E-07	3.77	4.21E-08	2.95	1.23E-08
10.86	6.04E-07	3.74	3.71E-08	2.95	1.28E-08
10.54	5.57E-07	3.71	3.36E-08	2.94	1.23E-08
10.23	5.20E-07	3.69	3.58E-08	2.93	1.21E-08
9.93	4.87E-07	3.66	3.52E-08	2.92	1.23E-08
9.63	4.45E-07	3.63	3.49E-08	2.92	1.25E-08
9.35	4.14E-07	3.61	3.50E-08	2.91	1.20E-08
9.08	3.91E-07	3.58	3.47E-08	2.90	1.40E-08
8.81	3.65E-07	3.56	3.36E-08	2.89	1.45E-08
8.55	3.35E-07	3.53	3.36E-08	2.89	1.06E-08
8.30	3.10E-07	3.51	3.21E-08	2.88	9.17E-09
8.05	2.92E-07	3.49	2.96E-08	2.87	1.08E-08
7.81	2.71E-07	3.47	2.92E-08	2.87	1.38E-08
7.58	2.50E-07	3.45	2.92E-08	2.86	1.35E-08
7.36	2.30E-07	3.43	2.84E-08	2.85	1.09E-08
7.14	2.14E-07	3.41	2.76E-08	2.85	8.94E-09
6.92	2.01E-07	3.39	2.64E-08	2.84	7.52E-09
6.72	1.86E-07	3.37	2.54E-08	2.84	9.66E-09
6.52	1.73E-07	3.35	2.56E-08	2.83	1.18E-08

6.33	1.61E-07	3.34	2.55E-08	2.82	1.08E-08
6.15	1.51E-07	3.32	2.48E-08	2.82	9.44E-09
5.97	1.41E-07	3.30	2.43E-08	2.81	9.22E-09
5.81	1.31E-07	3.29	2.39E-08	2.81	9.08E-09
5.66	1.21E-07	3.27	2.28E-08	2.80	1.06E-08
5.52	1.15E-07	3.26	2.19E-08	2.80	9.98E-09
5.40	1.09E-07	3.24	2.14E-08	2.79	6.90E-09
5.28	1.02E-07	3.23	2.14E-08	2.79	7.42E-09
5.18	9.81E-08	3.21	2.13E-08	2.78	9.94E-09
5.08	9.48E-08	3.20	2.04E-08	2.78	9.76E-09
4.98	9.06E-08	3.19	2.00E-08	2.77	8.83E-09
4.89	8.77E-08	3.17	2.00E-08	2.77	8.66E-09
4.81	8.22E-08	3.16	1.95E-08	2.76	7.38E-09
4.73	7.67E-08	3.15	1.88E-08	2.76	7.19E-09
4.66	7.42E-08	3.14	1.82E-08	2.75	7.64E-09
4.59	7.29E-08	3.12	1.76E-08	2.75	7.50E-09

Table B2. Constant-R (decreasing then increasing ΔK) FCG data for specimen 2 – L-T of D6AC Steel.

Specimen ID:	2			Orientation:	L-T
Test:	R = 0.1				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
8.22	2.19E-07	11.28	6.70E-07	22.28	4.18E-06
8.01	1.92E-07	11.63	7.22E-07	23.03	4.95E-06
7.78	1.66E-07	12.00	7.79E-07	23.69	5.42E-06
7.56	1.43E-07	12.38	8.38E-07	24.47	5.26E-06
7.34	1.25E-07	12.77	8.98E-07	25.18	5.62E-06
7.12	1.08E-07	13.17	9.65E-07	25.96	6.05E-06
6.92	8.98E-08	13.58	1.04E-06	26.79	6.48E-06
6.72	7.13E-08	14.00	1.12E-06	27.63	6.96E-06
6.53	5.68E-08	14.44	1.21E-06	28.51	7.49E-06
6.34	4.43E-08	14.89	1.31E-06	29.41	8.00E-06
6.15	3.00E-08	15.35	1.42E-06	30.33	8.53E-06
5.87	1.27E-08	15.85	1.56E-06	31.29	9.11E-06
5.77	1.02E-08	16.35	1.71E-06	32.27	9.68E-06
5.57	7.44E-09	16.86	1.87E-06	33.28	1.02E-05
5.56	8.19E-09	17.40	2.06E-06	34.33	1.09E-05
5.56	7.30E-09	17.94	2.26E-06	35.42	1.16E-05
5.55	2.72E-09	18.50	2.49E-06	36.52	1.24E-05
5.54	4.35E-09	19.09	2.72E-06	37.67	1.31E-05
5.54	6.51E-09	19.69	2.99E-06	38.83	1.39E-05
5.54	3.89E-09	20.30	3.26E-06	40.04	1.47E-05
5.53	6.08E-09	20.94	3.55E-06	41.28	1.56E-05
10.94	6.24E-07	21.60	3.87E-06		

Table B3. Constant-K_{max} FCG data for specimen 5 – L-T of D6AC Steel.

Specimen ID:	5			Orientation:	L-T
Test:	K_{max} = 15 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
13.80	9.50E-07	3.22	2.11E-08	2.53	4.25E-09
12.88	8.04E-07	3.18	2.05E-08	2.52	4.02E-09
12.31	6.94E-07	3.15	1.95E-08	2.52	4.08E-09
11.76	6.32E-07	3.11	1.96E-08	2.51	4.49E-09
11.24	5.91E-07	3.08	1.89E-08	2.51	4.38E-09
10.74	5.46E-07	3.05	1.71E-08	2.50	3.91E-09
10.26	4.84E-07	3.02	1.68E-08	2.50	3.71E-09
9.81	4.25E-07	3.00	1.57E-08	2.49	2.86E-09
9.36	3.94E-07	2.97	1.50E-08	2.49	2.72E-09
8.95	3.46E-07	2.95	1.43E-08	2.48	3.34E-09
8.55	2.99E-07	2.93	1.34E-08	2.48	3.30E-09
8.17	2.73E-07	2.91	1.32E-08	2.48	3.32E-09
7.81	2.42E-07	2.89	1.26E-08	2.47	3.39E-09
7.47	2.15E-07	2.87	1.20E-08	2.47	3.17E-09
7.14	1.89E-07	2.85	1.23E-08	2.46	3.07E-09
6.82	1.72E-07	2.83	1.16E-08	2.46	3.19E-09
6.52	1.60E-07	2.81	1.06E-08	2.45	2.95E-09
6.23	1.31E-07	2.80	1.03E-08	2.45	2.63E-09
5.94	1.18E-07	2.78	9.72E-09	2.45	2.43E-09
5.69	1.18E-07	2.77	9.84E-09	2.44	2.72E-09
5.43	1.08E-07	2.74	9.67E-09	2.44	3.03E-09
5.21	8.58E-08	2.73	7.94E-09	2.44	2.32E-09
4.99	7.57E-08	2.71	7.59E-09	2.44	8.31E-10
4.80	7.83E-08	2.70	8.29E-09	2.43	1.41E-09
4.62	7.37E-08	2.69	8.63E-09	2.43	2.02E-09
4.45	6.54E-08	2.68	8.60E-09	2.43	2.13E-09
4.30	5.84E-08	2.67	7.64E-09	2.42	3.18E-09
4.18	4.76E-08	2.65	7.87E-09	2.42	2.95E-09
4.06	4.31E-08	2.63	8.25E-09	2.42	7.08E-10
3.97	4.61E-08	2.61	7.14E-09	2.42	5.74E-12
3.88	4.44E-08	2.60	6.68E-09	2.42	1.64E-09
3.79	4.21E-08	2.60	6.13E-09	2.41	2.56E-09
3.70	3.99E-08	2.59	5.76E-09	2.41	2.80E-09
3.63	3.70E-08	2.58	5.51E-09	2.41	2.85E-09
3.56	3.35E-08	2.57	5.34E-09	2.40	2.86E-09
3.50	3.04E-08	2.56	5.08E-09	2.40	2.33E-09
3.44	2.85E-08	2.56	4.65E-09	2.40	2.32E-09
3.39	2.77E-08	2.55	4.71E-09	2.39	2.60E-09
3.34	2.59E-08	2.55	4.77E-09	2.39	2.28E-09
3.30	2.35E-08	2.54	3.38E-09		
3.25	2.20E-08	2.53	3.26E-09		

Table B4. Constant-R (increasing ΔK) FCG data for specimen 5 – L-T of D6AC Steel.

Specimen ID:	5			Orientation:	L-T
Test:	R = 0.3				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
13.06	1.05E-06	19.53	3.52E-06	29.13	9.19E-06
13.66	1.19E-06	20.42	3.80E-06	30.46	1.01E-05
14.29	1.39E-06	21.33	4.39E-06	31.85	1.09E-05
14.93	1.67E-06	22.29	4.90E-06	33.30	1.23E-05
15.62	1.92E-06	23.33	5.46E-06	34.82	1.50E-05
16.32	2.14E-06	24.39	6.06E-06	36.43	2.06E-05
17.09	2.40E-06	25.51	6.69E-06	39.90	5.16E-05
17.86	2.78E-06	26.67	7.33E-06		
18.70	3.25E-06	27.87	8.09E-06		

Table B5. Constant-R (decreasing then increasing ΔK) FCG data for specimen 8 – L-T of D6AC Steel.

Specimen ID:	8			Orientation:	L-T
Test:	R = 0.1				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
10.68	3.53E-07	6.63	4.86E-08	14.95	1.03E-06
9.82	2.91E-07	6.70	5.33E-08	15.23	1.09E-06
9.39	2.51E-07	6.77	5.74E-08	15.50	1.14E-06
8.99	2.06E-07	6.86	6.27E-08	15.78	1.19E-06
6.64	6.56E-08	6.95	6.92E-08	16.07	1.25E-06
6.95	5.35E-08	7.05	7.60E-08	16.35	1.30E-06
6.48	4.12E-08	7.16	8.28E-08	16.65	1.36E-06
6.36	3.35E-08	7.28	8.97E-08	16.96	1.43E-06
6.26	2.70E-08	7.41	9.94E-08	17.27	1.52E-06
6.18	2.17E-08	7.54	1.12E-07	17.58	1.61E-06
6.12	1.78E-08	7.68	1.24E-07	17.90	1.72E-06
6.07	1.47E-08	7.82	1.34E-07	18.22	1.84E-06
6.02	1.46E-08	7.97	1.47E-07	18.54	1.96E-06
5.99	1.19E-08	8.11	1.64E-07	18.88	2.10E-06
5.95	8.19E-09	8.26	1.79E-07	19.22	2.26E-06
5.93	7.04E-09	8.41	1.94E-07	19.58	2.43E-06
5.91	6.50E-09	8.56	2.07E-07	19.95	2.60E-06
5.89	5.64E-09	8.71	2.22E-07	20.31	2.77E-06
5.88	4.92E-09	8.88	2.40E-07	20.67	2.96E-06
5.94	7.72E-09	9.04	2.63E-07	21.04	3.17E-06
5.94	8.12E-09	9.20	2.85E-07	21.42	3.38E-06
6.01	8.51E-09	9.37	3.08E-07	21.81	3.58E-06
6.02	7.06E-09	9.54	3.29E-07	22.21	3.77E-06
6.03	6.64E-09	9.71	3.47E-07	22.61	3.97E-06
6.04	8.46E-09	9.89	3.55E-07	23.02	4.23E-06
6.05	9.38E-09	10.06	3.75E-07	23.44	4.52E-06
6.06	9.60E-09	10.25	4.17E-07	23.87	4.79E-06

6.07	1.03E-08	10.43	4.49E-07	24.30	5.08E-06
6.09	1.05E-08	10.62	4.66E-07	24.74	5.38E-06
6.10	1.14E-08	10.82	4.81E-07	25.19	5.67E-06
6.11	1.20E-08	11.01	4.99E-07	25.64	5.94E-06
6.13	1.19E-08	11.21	5.26E-07	26.11	6.21E-06
6.14	1.18E-08	11.42	5.40E-07	26.58	6.49E-06
6.16	1.30E-08	11.63	5.50E-07	27.06	6.79E-06
6.18	1.63E-08	11.84	5.80E-07	27.56	7.08E-06
6.20	1.95E-08	12.05	6.09E-07	28.05	7.38E-06
6.22	2.07E-08	12.27	6.28E-07	28.56	7.70E-06
6.25	2.01E-08	12.49	6.51E-07	29.08	8.02E-06
6.27	1.95E-08	12.72	6.85E-07	29.61	8.34E-06
6.30	2.09E-08	12.95	7.11E-07	30.15	8.66E-06
6.33	2.37E-08	13.19	7.46E-07	30.70	8.98E-06
6.36	2.57E-08	13.42	7.89E-07	31.26	9.29E-06
6.39	2.71E-08	13.67	8.28E-07	31.82	9.65E-06
6.43	2.92E-08	13.91	8.73E-07	32.40	1.01E-05
6.47	3.35E-08	14.16	9.12E-07	32.98	1.06E-05
6.52	3.92E-08	14.42	9.48E-07	33.57	1.10E-05
6.57	4.38E-08	14.69	9.90E-07	34.17	1.10E-05

Table B6. Constant-R (increasing ΔK) FCG data for specimen 10 – L-T of D6AC Steel.

Specimen ID:	10			Orientation:	L-T
Test:	R = 0.3				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
10.64	5.60E-07	18.87	2.74E-06	39.86	1.65E-05
10.64	5.45E-07	19.38	2.98E-06	40.94	1.76E-05
10.64	5.41E-07	19.91	3.24E-06	42.03	1.88E-05
10.64	5.24E-07	20.45	3.51E-06	43.17	2.00E-05
10.63	5.16E-07	21.01	3.78E-06	44.35	2.14E-05
10.63	5.12E-07	21.56	4.07E-06	45.55	2.30E-05
10.70	5.15E-07	22.15	4.37E-06	46.79	2.46E-05
10.84	5.26E-07	22.76	4.69E-06	48.03	2.65E-05
11.06	5.48E-07	23.38	5.03E-06	49.32	2.85E-05
11.36	5.83E-07	24.02	5.38E-06	50.64	3.08E-05
11.68	6.27E-07	24.68	5.75E-06	51.99	3.33E-05
11.99	6.76E-07	25.34	6.14E-06	53.41	3.59E-05
12.32	7.30E-07	26.02	6.52E-06	54.87	3.88E-05
12.66	7.88E-07	26.72	6.92E-06	56.36	4.22E-05
13.00	8.50E-07	27.43	7.36E-06	57.90	4.58E-05
13.35	9.18E-07	28.18	7.79E-06	59.45	5.01E-05
13.71	9.94E-07	28.94	8.24E-06	61.06	5.61E-05
14.08	1.08E-06	29.71	8.75E-06	62.69	6.32E-05
14.46	1.16E-06	30.52	9.26E-06	64.59	7.00E-05
14.85	1.26E-06	31.35	9.78E-06	66.15	7.70E-05
15.25	1.37E-06	32.20	1.03E-05	68.12	8.17E-05
15.67	1.49E-06	33.08	1.10E-05	69.73	8.91E-05
16.09	1.63E-06	33.98	1.16E-05	71.58	9.67E-05
16.53	1.78E-06	34.89	1.23E-05	73.51	1.06E-04
16.97	1.94E-06	35.81	1.30E-05	75.49	1.16E-04
17.43	2.12E-06	36.80	1.38E-05	77.57	1.27E-04
17.90	2.31E-06	37.78	1.46E-05	79.63	1.36E-04
18.37	2.52E-06	38.82	1.55E-05	81.82	1.53E-04

Table B7. Constant-R (increasing ΔK) FCG data for specimen 12 – L-T of D6AC Steel.

Specimen ID:	12			Orientation:	L-T
Test:	R = 0.9				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
6.00	1.75E-07	9.04	5.07E-07	13.76	2.67E-06
6.06	1.79E-07	9.20	5.32E-07	13.99	3.19E-06
6.15	1.86E-07	9.36	5.60E-07	14.25	3.54E-06
6.26	1.94E-07	9.52	5.88E-07	14.48	4.02E-06
6.37	2.02E-07	9.69	6.16E-07	14.73	4.50E-06
6.48	2.11E-07	9.86	6.49E-07	14.99	5.09E-06
6.60	2.21E-07	10.03	6.84E-07	15.25	5.88E-06
6.71	2.31E-07	10.21	7.20E-07	15.53	6.84E-06
6.83	2.42E-07	10.39	7.59E-07	15.81	7.82E-06
6.95	2.53E-07	10.57	8.01E-07	16.09	8.96E-06
7.08	2.65E-07	10.76	8.49E-07	16.37	1.02E-05
7.20	2.77E-07	10.96	9.00E-07	16.66	1.15E-05
7.33	2.90E-07	11.16	9.55E-07	16.95	1.28E-05
7.46	3.04E-07	11.35	1.02E-06	17.25	1.43E-05
7.59	3.18E-07	11.55	1.09E-06	17.55	1.60E-05
7.72	3.32E-07	11.75	1.16E-06	17.85	1.77E-05
7.86	3.47E-07	11.95	1.22E-06	18.17	2.00E-05
8.00	3.62E-07	12.16	1.27E-06	18.48	2.38E-05
8.14	3.79E-07	12.37	1.33E-06	18.81	3.26E-05
8.28	3.98E-07	12.60	1.38E-06	19.15	4.71E-05
8.43	4.17E-07	12.82	1.47E-06	19.52	6.29E-05
8.58	4.37E-07	13.05	1.63E-06	19.89	1.78E-04
8.73	4.58E-07	13.28	1.88E-06		
8.88	4.81E-07	13.51	2.24E-06		

Table B8. Constant-R (decreasing then increasing ΔK) FCG data for specimen 21 – L-T of D6AC Steel.

Specimen ID:	21			Orientation:	L-T
Test:	R = 0.3				
ΔK ($ksi\ in^{1/2}$)	da/dN (inch/cycle)	ΔK ($ksi\ in^{1/2}$)	da/dN (inch/cycle)	ΔK ($ksi\ in^{1/2}$)	da/dN (inch/cycle)
11.44	6.24E-07	11.22	6.70E-07	27.63	7.47E-06
9.90	4.23E-07	11.43	6.97E-07	28.13	7.76E-06
9.72	4.04E-07	11.63	7.21E-07	28.64	8.06E-06
9.55	3.82E-07	11.85	7.45E-07	29.17	8.37E-06
9.38	3.62E-07	12.06	7.74E-07	29.70	8.68E-06
9.21	3.44E-07	12.28	8.10E-07	30.25	9.01E-06
9.04	3.25E-07	12.51	8.46E-07	30.80	9.35E-06
8.88	3.08E-07	12.73	8.78E-07	31.36	9.65E-06
8.72	2.94E-07	12.97	9.16E-07	31.93	1.00E-05
8.57	2.80E-07	13.21	9.58E-07	32.50	1.04E-05
8.42	2.64E-07	13.45	1.00E-06	33.09	1.08E-05
8.27	2.51E-07	13.69	1.05E-06	33.70	1.12E-05
8.12	2.39E-07	13.94	1.10E-06	34.30	1.16E-05
7.97	2.26E-07	14.19	1.15E-06	34.93	1.20E-05
7.83	2.15E-07	14.45	1.21E-06	35.56	1.25E-05
7.69	2.04E-07	14.71	1.27E-06	36.20	1.29E-05
7.55	1.93E-07	14.98	1.34E-06	36.85	1.34E-05
7.42	1.80E-07	15.25	1.42E-06	37.52	1.40E-05
7.29	1.68E-07	15.53	1.50E-06	38.20	1.45E-05
7.16	1.57E-07	15.81	1.58E-06	38.90	1.50E-05
7.03	1.45E-07	16.10	1.68E-06	39.61	1.56E-05
6.91	1.33E-07	16.40	1.79E-06	40.33	1.62E-05
6.78	1.22E-07	16.69	1.89E-06	41.07	1.69E-05
6.66	1.11E-07	16.99	2.01E-06	41.81	1.76E-05
6.54	9.77E-08	17.29	2.15E-06	42.58	1.83E-05
6.42	8.80E-08	17.61	2.27E-06	43.35	1.89E-05
6.31	8.18E-08	17.93	2.37E-06	44.14	1.95E-05
6.20	7.45E-08	18.26	2.51E-06	44.95	2.04E-05
6.09	6.80E-08	18.60	2.66E-06	45.77	2.13E-05
5.98	6.25E-08	18.94	2.81E-06	46.61	2.23E-05
5.87	5.54E-08	19.29	2.98E-06	47.44	2.33E-05
5.77	4.80E-08	19.63	3.14E-06	48.30	2.42E-05
5.67	4.27E-08	19.98	3.31E-06	49.16	2.52E-05
5.58	3.87E-08	20.34	3.48E-06	50.06	2.63E-05
5.50	3.47E-08	20.71	3.67E-06	50.98	2.76E-05
5.43	3.04E-08	21.09	3.86E-06	51.93	2.89E-05
5.36	2.58E-08	21.47	4.05E-06	52.88	3.04E-05
5.31	2.30E-08	21.87	4.26E-06	53.84	3.20E-05
5.26	2.05E-08	22.26	4.46E-06	54.79	3.41E-05
5.22	1.64E-08	22.66	4.67E-06	55.78	3.59E-05
5.19	1.38E-08	23.07	4.90E-06	56.77	3.73E-05
5.16	1.28E-08	23.49	5.12E-06	57.82	3.92E-05
5.14	1.14E-08	23.92	5.35E-06	58.87	4.18E-05
5.11	1.14E-08	24.36	5.58E-06	59.93	4.49E-05

5.09	9.75E-09	24.80	5.83E-06	61.02	4.83E-05
5.07	9.42E-09	25.24	6.07E-06	62.12	5.13E-05
5.03	8.66E-09	25.70	6.33E-06	63.26	5.36E-05
5.01	7.51E-09	26.17	6.62E-06	64.41	5.47E-05
10.67	6.19E-07	26.65	6.88E-06		
11.02	6.44E-07	27.14	7.17E-06		

Table B9. Constant-R (decreasing then increasing ΔK) FCG data for specimen 23 – L-T of D6AC Steel.

Specimen ID:	23			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
11.11	6.34E-07	3.70	3.13E-08	2.82	3.59E-09
10.91	5.93E-07	3.67	3.06E-08	2.82	5.54E-09
10.72	5.61E-07	3.65	2.74E-08	2.82	5.64E-09
10.53	5.46E-07	3.63	2.69E-08	2.82	7.94E-09
10.34	5.20E-07	3.61	3.06E-08	2.81	7.57E-09
10.16	4.89E-07	3.59	3.11E-08	2.81	4.68E-09
9.97	4.70E-07	3.57	2.62E-08	2.80	4.27E-09
9.79	4.49E-07	3.55	2.50E-08	2.80	5.68E-09
9.62	4.28E-07	3.53	2.46E-08	2.80	6.92E-09
9.45	4.11E-07	3.52	2.39E-08	2.80	6.21E-09
9.28	3.90E-07	3.50	2.54E-08	12.69	8.35E-07
9.12	3.72E-07	3.48	2.48E-08	13.01	9.00E-07
8.96	3.57E-07	3.47	2.32E-08	13.26	9.75E-07
8.80	3.40E-07	3.45	2.30E-08	13.48	1.20E-06
8.65	3.20E-07	3.43	2.23E-08	13.74	1.32E-06
8.49	3.15E-07	3.42	2.18E-08	14.00	1.44E-06
8.33	3.02E-07	3.40	2.28E-08	14.27	1.48E-06
8.18	2.77E-07	3.39	2.32E-08	14.55	1.51E-06
8.04	2.67E-07	3.37	2.04E-08	14.82	1.64E-06
7.90	2.56E-07	3.36	1.92E-08	15.10	1.74E-06
7.76	2.48E-07	3.35	1.86E-08	15.36	1.78E-06
7.62	2.40E-07	3.34	1.78E-08	15.64	1.84E-06
7.48	2.26E-07	3.32	1.97E-08	15.92	1.98E-06
7.35	2.16E-07	3.31	1.89E-08	16.22	2.09E-06
7.22	2.08E-07	3.30	1.92E-08	16.53	2.23E-06
7.09	1.98E-07	3.29	1.80E-08	16.83	2.29E-06
6.96	1.89E-07	3.27	1.75E-08	17.17	2.47E-06
6.84	1.79E-07	3.26	1.83E-08	17.47	2.62E-06
6.72	1.71E-07	3.25	1.56E-08	17.81	2.63E-06
6.60	1.62E-07	3.24	1.63E-08	18.13	2.78E-06
6.48	1.54E-07	3.23	1.65E-08	18.47	2.98E-06
6.37	1.44E-07	3.22	1.44E-08	18.80	3.17E-06
6.25	1.41E-07	3.21	1.40E-08	19.13	3.28E-06
6.14	1.51E-07	3.20	1.42E-08	19.49	3.42E-06
6.03	1.36E-07	3.19	1.52E-08	19.85	3.62E-06
5.92	1.20E-07	3.18	1.53E-08	20.21	3.78E-06

5.82	1.17E-07	3.17	1.30E-08	20.60	3.98E-06
5.72	1.11E-07	3.17	1.28E-08	20.98	4.14E-06
5.61	1.08E-07	3.16	1.12E-08	21.38	4.30E-06
5.52	1.05E-07	3.15	1.26E-08	21.78	4.48E-06
5.41	1.01E-07	3.14	1.47E-08	22.19	4.63E-06
5.23	7.92E-08	3.13	1.29E-08	22.59	4.73E-06
5.06	8.51E-08	3.13	1.22E-08	23.01	4.95E-06
4.98	8.15E-08	3.12	1.22E-08	23.43	5.35E-06
4.90	7.67E-08	3.11	1.35E-08	23.86	5.54E-06
4.82	7.55E-08	3.10	1.33E-08	24.29	5.66E-06
4.75	7.29E-08	3.10	1.16E-08	24.73	5.85E-06
4.69	6.73E-08	3.09	1.22E-08	25.20	6.15E-06
4.62	6.54E-08	3.08	1.26E-08	25.67	6.46E-06
4.57	6.27E-08	3.07	1.24E-08	26.17	6.65E-06
4.51	6.08E-08	3.06	1.14E-08	26.65	6.95E-06
4.46	5.94E-08	3.06	1.11E-08	27.14	7.19E-06
4.40	5.82E-08	3.05	1.20E-08	27.63	7.41E-06
4.36	5.61E-08	3.04	1.27E-08	28.15	7.81E-06
4.31	5.25E-08	3.04	1.21E-08	28.68	7.96E-06
4.26	5.20E-08	3.03	1.15E-08	29.22	8.00E-06
4.22	4.99E-08	3.02	1.16E-08	29.77	8.62E-06
4.18	4.73E-08	3.02	1.13E-08	30.31	9.29E-06
4.14	4.51E-08	2.99	1.09E-08	30.85	9.43E-06
4.10	4.46E-08	2.91	8.10E-09	31.40	9.80E-06
4.07	4.37E-08	2.88	8.04E-09	31.98	1.02E-05
4.03	4.28E-08	2.86	7.91E-09	32.59	1.06E-05
4.00	4.13E-08	2.86	6.37E-09	33.20	1.10E-05
3.97	3.84E-08	2.86	4.13E-09	33.83	1.15E-05
3.94	3.95E-08	2.85	3.67E-09	37.11	1.52E-05
3.91	3.89E-08	2.85	6.43E-09	37.80	1.61E-05
3.88	3.68E-08	2.85	7.80E-09	38.49	1.80E-05
3.85	3.62E-08	2.84	6.17E-09	39.19	1.89E-05
3.82	3.58E-08	2.84	6.02E-09	39.91	1.89E-05
3.79	3.47E-08	2.84	4.88E-09	40.65	1.97E-05
3.77	3.31E-08	2.83	3.63E-09	41.40	2.16E-05
3.74	3.29E-08	2.83	8.11E-09		
3.72	3.16E-08	2.83	6.40E-09		

Table B10. Constant-R (increasing ΔK) FCG data for specimen 25 – L-T of D6AC Steel.

Specimen ID:	25			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
4.58	6.53E-08	12.49	9.29E-07	35.61	1.37E-05
4.60	6.72E-08	12.84	1.00E-06	36.55	1.75E-05
4.66	7.01E-08	13.19	1.09E-06	37.52	1.97E-05
4.75	7.43E-08	13.55	1.19E-06	38.55	2.13E-05
4.88	7.99E-08	13.92	1.29E-06	39.61	2.21E-05
5.01	8.70E-08	14.30	1.40E-06	40.69	2.33E-05
5.15	9.49E-08	14.69	1.51E-06	41.81	2.59E-05
5.29	1.02E-07	15.08	1.63E-06	41.59	2.92E-05
5.44	1.09E-07	15.49	1.76E-06	41.21	2.22E-05
5.58	1.17E-07	15.90	1.90E-06	42.23	2.88E-05
5.74	1.24E-07	16.34	2.06E-06	43.40	3.42E-05
5.89	1.33E-07	16.78	2.24E-06	44.58	3.94E-05
6.05	1.43E-07	17.25	2.41E-06	44.67	3.30E-05
6.22	1.53E-07	17.72	2.60E-06	45.06	3.38E-05
6.39	1.64E-07	18.20	2.80E-06	45.46	3.38E-05
6.56	1.76E-07	18.70	3.03E-06	*45.87*	*3.77E-05*
6.74	1.90E-07	19.21	2.90E-06	*46.27*	*4.39E-05*
6.93	2.06E-07	19.74	2.89E-06	*46.68*	*4.68E-05*
7.12	2.27E-07	20.27	3.47E-06	*47.10*	*5.14E-05*
7.31	2.41E-07	20.82	4.06E-06	*47.52*	*5.83E-05*
7.51	2.53E-07	21.39	4.32E-06	*47.96*	*6.35E-05*
7.71	2.68E-07	21.96	4.60E-06	*48.39*	*6.67E-05*
7.92	2.80E-07	22.57	4.91E-06	*48.82*	*6.92E-05*
8.14	2.95E-07	23.18	5.25E-06	*49.26*	*7.72E-05*
8.36	3.15E-07	23.81	5.59E-06	*49.70*	*9.55E-05*
8.59	3.36E-07	24.45	6.06E-06	*50.13*	*1.14E-04*
8.82	3.62E-07	25.12	6.65E-06	*50.59*	*1.23E-04*
9.05	3.86E-07	25.79	7.14E-06	*51.03*	*1.28E-04*
9.30	4.12E-07	26.49	7.64E-06	*51.49*	*1.38E-04*
9.55	4.46E-07	27.20	8.01E-06	*51.94*	*1.74E-04*
9.81	4.81E-07	27.94	8.26E-06	*52.39*	*2.18E-04*
10.08	5.19E-07	28.70	8.73E-06	*52.85*	*2.49E-04*
10.36	5.59E-07	29.48	9.20E-06	*53.28*	*3.00E-04*
10.64	6.02E-07	30.29	9.64E-06	*53.74*	*3.69E-04*
10.94	6.43E-07	31.11	1.02E-05	*54.16*	*4.51E-04*
11.24	6.89E-07	31.96	1.08E-05	*54.58*	*6.18E-04*
11.54	7.40E-07	32.84	1.15E-05	*54.96*	*9.43E-04*
11.85	7.95E-07	33.77	1.18E-05	*55.32*	*1.41E-03*
12.17	8.64E-07	34.66	1.17E-05		

Table B11. Constant-R (increasing ΔK) FCG data for specimen 27 – L-T of D6AC Steel.

Specimen ID:	27			Orientation:	L-T
Test:	R = 0.9				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
5.25	1.13E-07	8.32	4.10E-07	13.15	1.71E-06
5.27	1.21E-07	8.37	4.15E-07	13.23	1.75E-06
5.31	1.28E-07	8.42	4.21E-07	13.31	1.80E-06
5.34	1.35E-07	8.47	4.27E-07	13.39	1.85E-06
5.37	1.37E-07	8.52	4.34E-07	13.47	1.91E-06
5.41	1.39E-07	8.57	4.42E-07	13.55	1.98E-06
5.44	1.41E-07	8.63	4.50E-07	13.64	2.05E-06
5.47	1.44E-07	8.68	4.58E-07	13.72	2.12E-06
5.51	1.47E-07	8.73	4.64E-07	13.80	2.19E-06
5.54	1.50E-07	8.78	4.69E-07	13.88	2.27E-06
5.57	1.53E-07	8.84	4.73E-07	13.97	2.36E-06
5.61	1.54E-07	8.89	4.76E-07	14.05	2.46E-06
5.64	1.56E-07	8.94	4.81E-07	14.14	2.58E-06
5.68	1.57E-07	9.00	4.89E-07	14.22	2.70E-06
5.71	1.59E-07	9.05	4.99E-07	14.31	2.80E-06
5.75	1.60E-07	9.11	5.10E-07	14.39	2.89E-06
5.78	1.62E-07	9.16	5.22E-07	14.48	2.99E-06
5.82	1.65E-07	9.22	5.32E-07	14.57	3.08E-06
5.85	1.68E-07	9.28	5.36E-07	14.66	3.15E-06
5.89	1.71E-07	9.33	5.41E-07	14.74	3.25E-06
5.92	1.74E-07	9.39	5.47E-07	14.83	3.32E-06
5.96	1.77E-07	9.45	5.55E-07	14.92	3.37E-06
5.99	1.79E-07	9.50	5.66E-07	15.01	3.45E-06
6.03	1.81E-07	9.56	5.83E-07	15.10	3.68E-06
6.07	1.85E-07	9.62	6.00E-07	15.19	3.97E-06
6.10	1.89E-07	9.68	6.15E-07	15.28	4.21E-06
6.14	1.93E-07	9.74	6.26E-07	15.37	4.45E-06
6.18	1.96E-07	9.80	6.34E-07	15.47	4.67E-06
6.22	1.98E-07	9.86	6.39E-07	15.56	4.84E-06
6.26	2.01E-07	9.92	6.46E-07	15.65	4.97E-06
6.29	2.05E-07	9.98	6.57E-07	15.75	5.15E-06
6.33	2.09E-07	10.04	6.69E-07	15.84	5.34E-06
6.37	2.14E-07	10.10	6.83E-07	15.94	5.49E-06
6.41	2.17E-07	10.16	6.98E-07	16.03	5.70E-06
6.45	2.19E-07	10.22	7.14E-07	16.13	6.02E-06
6.49	2.21E-07	10.28	7.26E-07	16.23	6.54E-06
6.53	2.25E-07	10.34	7.41E-07	16.33	7.13E-06
6.57	2.28E-07	10.41	7.56E-07	16.42	7.62E-06
6.61	2.31E-07	10.47	7.73E-07	16.52	8.12E-06
6.65	2.34E-07	10.53	7.87E-07	16.62	8.50E-06
6.69	2.36E-07	10.60	7.95E-07	16.72	8.70E-06
6.73	2.40E-07	10.66	8.01E-07	16.82	8.91E-06
6.77	2.44E-07	10.73	8.07E-07	16.93	9.27E-06
6.81	2.49E-07	10.79	8.15E-07	17.03	9.84E-06

6.85	2.54E-07	10.86	8.25E-07	17.13	1.04E-05
6.89	2.57E-07	10.92	8.45E-07	17.23	1.09E-05
6.93	2.59E-07	10.99	8.67E-07	*17.33*	*1.13E-05*
6.98	2.61E-07	11.05	8.85E-07	*17.44*	*1.16E-05*
7.02	2.64E-07	11.12	9.04E-07	*17.54*	*1.17E-05*
7.06	2.67E-07	11.19	9.22E-07	*17.65*	*1.19E-05*
7.10	2.70E-07	11.25	9.48E-07	*17.75*	*1.23E-05*
7.15	2.74E-07	11.32	9.72E-07	*17.86*	*1.28E-05*
7.19	2.80E-07	11.39	9.92E-07	*17.97*	*1.37E-05*
7.23	2.86E-07	11.46	1.01E-06	*18.07*	*1.46E-05*
7.28	2.91E-07	11.53	1.03E-06	*18.18*	*1.58E-05*
7.32	2.95E-07	11.59	1.05E-06	*18.29*	*1.71E-05*
7.37	2.98E-07	11.66	1.06E-06	*18.40*	*1.81E-05*
7.41	3.00E-07	11.73	1.08E-06	*18.52*	*1.88E-05*
7.46	3.04E-07	11.81	1.10E-06	*18.63*	*1.96E-05*
7.50	3.09E-07	11.88	1.12E-06	*18.74*	*2.06E-05*
7.55	3.16E-07	11.95	1.14E-06	*18.85*	*2.19E-05*
7.59	3.24E-07	12.02	1.17E-06	*18.96*	*2.37E-05*
7.64	3.31E-07	12.09	1.20E-06	*19.08*	*2.58E-05*
7.69	3.36E-07	12.17	1.23E-06	*19.19*	*2.86E-05*
7.73	3.39E-07	12.24	1.28E-06	*19.31*	*3.26E-05*
7.78	3.42E-07	12.31	1.32E-06	*19.43*	*3.83E-05*
7.83	3.45E-07	12.39	1.35E-06	*19.54*	*4.49E-05*
7.88	3.48E-07	12.46	1.39E-06	*19.66*	*5.17E-05*
7.92	3.53E-07	12.54	1.42E-06	*19.77*	*6.04E-05*
7.97	3.63E-07	12.61	1.45E-06	*19.89*	*7.44E-05*
8.02	3.74E-07	12.69	1.49E-06	*20.01*	*1.01E-04*
8.07	3.82E-07	12.77	1.53E-06	*20.12*	*1.43E-04*
8.12	3.89E-07	12.84	1.58E-06	*20.23*	*2.00E-04*
8.17	3.94E-07	12.92	1.61E-06	*20.34*	*2.92E-04*
8.22	4.00E-07	13.00	1.65E-06	*20.41*	*5.24E-04*
8.27	4.05E-07	13.08	1.68E-06	*20.48*	*8.77E-04*

Table B12. Constant-R (decreasing ΔK) FCG data for specimen 28 – L-T of D6AC Steel.

Specimen ID:	28			Orientation:	L-T
Test:	R = 0.1				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
10.81	5.54E-07	10.89	5.20E-07	8.28	1.70E-07
10.81	5.50E-07	10.84	5.12E-07	8.14	1.53E-07
10.82	5.44E-07	10.75	5.01E-07	8.00	1.36E-07
10.82	5.40E-07	10.60	4.83E-07	7.86	1.23E-07
10.83	5.37E-07	10.41	4.60E-07	7.72	1.10E-07
10.83	5.34E-07	10.23	4.22E-07	7.59	1.01E-07
10.84	5.33E-07	10.05	3.91E-07	7.46	8.92E-08
10.84	5.32E-07	9.88	3.61E-07	7.32	7.52E-08
10.85	5.30E-07	9.71	3.35E-07	7.20	6.17E-08
10.86	5.30E-07	9.54	3.13E-07	7.07	5.22E-08
10.86	5.29E-07	9.37	2.93E-07	6.99	4.69E-08
10.87	5.28E-07	9.21	2.75E-07	6.93	4.47E-08
10.87	5.26E-07	9.04	2.56E-07	6.91	4.49E-08
10.88	5.24E-07	8.89	2.38E-07	6.92	4.39E-08
10.88	5.24E-07	8.73	2.20E-07	6.92	4.34E-08
10.88	5.25E-07	8.58	2.03E-07	6.92	4.23E-08
10.89	5.22E-07	8.43	1.86E-07	6.92	4.11E-08

Table B13. Constant-R (increasing ΔK) FCG data for specimen 29 – L-T of D6AC Steel.

Specimen ID:	29			Orientation:	L-T
Test:	R = 0.3				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
59.49	5.08E-05	78.07	1.25E-04	103.33	3.40E-04
60.19	5.09E-05	80.24	1.37E-04	106.07	3.97E-04
61.11	5.49E-05	82.47	1.51E-04	108.93	4.75E-04
62.72	5.97E-05	84.75	1.68E-04	111.89	5.65E-04
64.43	6.53E-05	87.08	1.87E-04	114.76	7.14E-04
66.22	7.17E-05	89.53	2.08E-04	117.87	9.04E-04
68.09	7.87E-05	91.95	2.33E-04	120.73	1.19E-03
69.95	8.73E-05	94.50	2.20E-04	123.73	1.48E-03
71.91	9.63E-05	95.46	2.09E-04	126.78	1.82E-03
73.93	1.05E-04	98.01	2.47E-04	*130.03*	*1.91E-03*
75.96	1.14E-04	100.60	2.90E-04		

Table B14. Constant-K_{max} FCG data for for specimen 30 – L-T of D6AC Steel.

Specimen ID:	30			Orientation:	L-T
Test:	K_{max} = 20 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
18.02	2.04E-06	5.30	9.53E-08	2.41	2.25E-09
17.74	2.14E-06	4.62	6.18E-08	2.41	5.89E-10
16.55	2.36E-06	4.05	5.13E-08	2.39	1.27E-09
15.35	1.85E-06	3.54	3.44E-08	2.38	2.95E-09
13.36	1.10E-06	3.12	1.46E-08	2.36	2.40E-09
11.70	6.96E-07	2.76	7.21E-09	2.34	1.50E-09
10.23	5.10E-07	2.57	4.33E-09	2.32	1.96E-09
8.96	3.88E-07	2.44	1.92E-09	2.31	1.74E-09
7.81	2.73E-07	2.42	1.80E-09	2.30	1.04E-09
6.89	1.85E-07	2.42	3.17E-09	2.29	1.45E-09
6.02	1.37E-07	2.42	4.54E-09		

Table B15. Constant-K_{max} FCG data for for specimen 30 – L-T of D6AC Steel.

Specimen ID:	30			Orientation:	L-T
Test:	K_{max} = 30 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
19.47	5.58E-06	6.92	2.10E-07	2.36	3.19E-09
17.75	4.00E-06	6.66	2.02E-07	2.34	2.80E-09
16.26	2.98E-06	6.26	1.59E-07	2.33	2.61E-09
14.87	2.29E-06	5.77	1.36E-07	2.31	2.31E-09
13.62	1.73E-06	5.28	1.10E-07	2.27	2.41E-09
12.46	1.30E-06	4.82	8.84E-08	2.26	2.20E-09
11.39	1.00E-06	4.40	7.03E-08	2.25	1.68E-09
10.40	7.54E-07	4.01	5.46E-08	2.24	1.39E-09
9.51	5.74E-07	3.67	4.08E-08	2.24	1.37E-09
8.68	4.49E-07	3.35	2.91E-08	2.22	1.69E-09
7.96	3.71E-07	2.50	6.87E-09	2.22	1.43E-09
7.24	2.90E-07	2.45	5.41E-09	2.21	1.65E-09
6.71	2.29E-07	2.44	3.87E-09	2.19	1.26E-09
6.05	1.75E-07	2.43	4.39E-09	2.18	1.06E-09
5.58	1.57E-07	2.41	4.48E-09	2.18	1.08E-09
5.08	1.28E-07	2.39	4.03E-09		
4.63	8.71E-08	2.37	3.56E-09		

Table B16. Constant-R (decreasing ΔK) FCG data for specimen 31 L – T of D6AC Steel.

Specimen ID:	31			Orientation:	L-T
Test:	R = 0.1				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
7.07	5.69E-08	6.46	1.63E-08	6.16	6.18E-09
7.03	6.21E-08	6.36	9.12E-09	6.12	5.78E-09
6.96	6.77E-08	6.31	7.68E-09	6.09	5.79E-09
6.86	6.23E-08	6.26	7.05E-09	6.05	5.92E-09
6.72	5.10E-08	6.23	6.54E-09	6.02	6.57E-09
6.59	2.90E-08	6.20	7.08E-09	5.98	8.63E-09

Table B17. Constant-R (increasing ΔK) FCG data for specimen 32 L – T of D6AC Steel.

Specimen ID:	32			Orientation:	L-T
Test:	R = 0.1				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
9.08	2.27E-07	21.49	3.30E-06	52.61	3.08E-05
9.11	2.34E-07	21.92	3.52E-06	53.65	3.25E-05
9.19	2.46E-07	22.36	3.74E-06	54.73	3.43E-05
9.32	2.62E-07	22.80	3.99E-06	55.81	3.62E-05
9.50	2.81E-07	23.26	4.24E-06	56.96	3.79E-05
9.69	3.03E-07	23.73	4.49E-06	58.09	4.01E-05
9.89	3.28E-07	24.22	4.76E-06	59.27	4.23E-05
10.09	3.51E-07	24.71	5.03E-06	60.48	4.46E-05
10.29	3.76E-07	25.20	5.32E-06	61.68	4.73E-05
10.50	4.03E-07	25.71	5.61E-06	62.94	5.01E-05
10.72	4.31E-07	26.22	5.92E-06	64.21	5.33E-05
10.93	4.62E-07	26.75	6.26E-06	65.51	5.66E-05
11.15	4.96E-07	27.30	6.59E-06	66.83	6.04E-05
11.37	5.29E-07	27.85	6.94E-06	68.16	6.46E-05
11.60	5.66E-07	28.41	7.29E-06	69.55	6.88E-05
11.83	6.06E-07	28.97	7.66E-06	70.94	7.35E-05
12.07	6.46E-07	29.55	8.06E-06	72.38	7.82E-05
12.31	6.87E-07	30.15	8.44E-06	73.86	8.32E-05
12.56	7.30E-07	30.75	8.88E-06	75.30	8.94E-05
12.81	7.75E-07	31.37	9.34E-06	76.81	9.56E-05
13.07	8.17E-07	32.00	9.78E-06	78.33	1.03E-04
13.33	8.58E-07	32.63	1.02E-05	79.91	1.11E-04
13.61	8.95E-07	33.28	1.07E-05	81.54	1.20E-04
13.88	9.33E-07	33.95	1.12E-05	83.19	1.28E-04
14.16	9.77E-07	34.64	1.17E-05	84.85	1.39E-04
14.44	1.03E-06	35.35	1.22E-05	86.52	1.49E-04
14.74	1.08E-06	36.06	1.27E-05	88.24	1.61E-04
15.03	1.13E-06	36.79	1.32E-05	90.02	1.74E-04
15.33	1.18E-06	37.52	1.37E-05	91.86	1.89E-04
15.64	1.23E-06	38.28	1.43E-05	93.69	2.06E-04

15.95	1.29E-06	39.05	1.49E-05	95.58	2.24E-04
16.28	1.35E-06	39.83	1.56E-05	97.44	2.44E-04
16.60	1.41E-06	40.63	1.63E-05	99.36	2.65E-04
16.93	1.48E-06	41.43	1.71E-05	101.34	2.83E-04
17.27	1.56E-06	42.27	1.79E-05	103.33	3.14E-04
17.62	1.65E-06	43.10	1.87E-05	105.37	3.55E-04
17.97	1.76E-06	43.97	1.96E-05	107.26	3.98E-04
18.33	1.89E-06	44.86	2.04E-05	109.41	4.32E-04
18.69	2.02E-06	45.76	2.13E-05	111.49	4.68E-04
19.07	2.18E-06	46.68	2.23E-05	113.76	5.20E-04
19.46	2.34E-06	47.63	2.33E-05	116.06	6.84E-04
19.86	2.52E-06	48.59	2.45E-05	118.23	6.46E-04
20.26	2.70E-06	49.57	2.59E-05	120.75	1.23E-03
20.66	2.89E-06	50.57	2.75E-05		
21.08	3.08E-06	51.58	2.91E-05		

Table B18. Constant-R (decreasing then increasing ΔK) FCG data for specimen 33 L – T of D6AC Steel.

Specimen ID:	33			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
8.75	3.46E-07	3.13	1.66E-08	14.84	1.86E-06
8.60	3.16E-07	3.11	1.66E-08	15.10	1.97E-06
8.45	3.06E-07	3.09	1.61E-08	15.37	2.11E-06
8.29	2.92E-07	3.07	1.49E-08	15.64	2.26E-06
8.14	2.73E-07	3.05	1.42E-08	15.91	2.36E-06
7.99	2.67E-07	3.03	1.34E-08	16.20	2.44E-06
7.85	2.52E-07	3.01	1.28E-08	16.48	2.66E-06
7.70	2.37E-07	3.00	1.21E-08	16.78	2.81E-06
7.56	2.28E-07	2.98	1.23E-08	17.08	2.92E-06
7.42	2.17E-07	2.96	1.29E-08	17.39	3.12E-06
7.28	2.08E-07	2.95	1.13E-08	17.70	3.34E-06
7.15	1.99E-07	2.93	1.01E-08	18.00	3.46E-06
7.02	1.90E-07	2.92	1.08E-08	18.32	3.58E-06
6.89	1.80E-07	2.91	1.13E-08	18.62	3.77E-06
6.76	1.72E-07	2.89	9.64E-09	18.95	3.88E-06
6.64	1.65E-07	2.88	7.51E-09	19.28	4.19E-06
6.52	1.55E-07	2.87	8.40E-09	19.61	4.33E-06
6.40	1.46E-07	2.86	9.62E-09	19.96	4.50E-06
6.28	1.40E-07	2.85	9.08E-09	20.30	4.84E-06
6.16	1.36E-07	2.84	8.55E-09	20.66	4.97E-06
6.05	1.32E-07	2.83	9.27E-09	21.03	5.13E-06
5.94	1.29E-07	2.82	9.03E-09	21.41	5.42E-06
5.83	1.23E-07	2.81	8.90E-09	21.78	5.78E-06
5.73	1.15E-07	2.80	9.12E-09	22.17	5.97E-06
5.62	1.13E-07	2.79	6.50E-09	22.55	6.24E-06
5.52	1.10E-07	2.78	5.66E-09	22.94	6.57E-06
5.41	1.03E-07	2.77	7.20E-09	23.34	6.69E-06

5.32	9.82E-08	2.76	7.29E-09	23.75	6.91E-06
5.22	9.35E-08	2.75	7.58E-09	24.18	7.30E-06
5.13	8.84E-08	2.75	6.49E-09	24.61	7.46E-06
5.03	8.52E-08	2.74	5.10E-09	25.04	7.74E-06
4.94	8.09E-08	2.73	6.39E-09	25.47	8.12E-06
4.85	7.65E-08	2.72	7.01E-09	25.93	8.23E-06
4.76	7.19E-08	2.72	6.80E-09	26.38	8.68E-06
4.67	7.00E-08	2.71	6.19E-09	26.85	9.29E-06
4.59	6.76E-08	2.70	5.73E-09	27.33	9.35E-06
4.50	6.39E-08	2.70	6.00E-09	27.79	9.66E-06
4.42	6.08E-08	9.42	4.81E-07	28.28	1.02E-05
4.34	5.69E-08	9.60	4.86E-07	28.78	1.02E-05
4.26	5.30E-08	9.76	5.15E-07	29.29	1.08E-05
4.18	5.07E-08	9.94	5.57E-07	29.82	1.22E-05
4.11	4.85E-08	10.11	5.71E-07	30.33	1.26E-05
4.03	4.61E-08	10.29	5.81E-07	30.88	1.29E-05
3.96	4.33E-08	10.47	6.19E-07	31.40	1.38E-05
3.89	4.07E-08	10.66	6.44E-07	31.96	1.45E-05
3.82	3.88E-08	10.85	6.75E-07	32.51	1.47E-05
3.76	3.63E-08	11.04	7.15E-07	33.08	1.49E-05
3.70	3.41E-08	11.23	7.46E-07	*33.65*	*1.60E-05*
3.65	3.21E-08	11.43	7.83E-07	*34.25*	*1.81E-05*
3.60	3.00E-08	11.63	8.17E-07	*34.85*	*1.95E-05*
3.55	2.94E-08	11.84	8.61E-07	*35.48*	*1.98E-05*
3.51	2.83E-08	12.05	9.22E-07	*36.08*	*2.03E-05*
3.47	2.65E-08	12.26	9.79E-07	*36.96*	*2.34E-05*
3.43	2.53E-08	12.48	1.03E-06	*37.53*	*3.88E-05*
3.39	2.44E-08	12.70	1.09E-06	*38.26*	*4.36E-05*
3.36	2.36E-08	12.93	1.18E-06	*38.91*	*2.90E-05*
3.32	2.28E-08	13.15	1.23E-06	*39.42*	*3.68E-05*
3.29	2.16E-08	13.38	1.27E-06	*40.10*	*4.52E-05*
3.26	2.08E-08	13.61	1.35E-06	*40.83*	*5.61E-05*
3.23	2.04E-08	13.84	1.47E-06	*41.52*	*7.28E-05*
3.20	1.99E-08	14.07	1.57E-06	*42.27*	*1.02E-04*
3.18	1.90E-08	14.33	1.65E-06		
3.15	1.74E-08	14.58	1.77E-06		

Table B19. Constant-R (decreasing then increasing ΔK) FCG data for specimen 41 L – T of D6AC Steel.

Specimen ID:	41			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
8.07	2.68E-07	3.32	1.86E-08	10.74	5.76E-07
7.93	2.53E-07	3.31	1.85E-08	10.93	6.05E-07
7.79	2.42E-07	3.29	1.70E-08	11.13	6.35E-07
7.65	2.29E-07	3.28	1.65E-08	11.33	6.73E-07
7.51	2.18E-07	3.27	1.67E-08	11.54	7.15E-07
7.38	2.08E-07	3.26	1.70E-08	11.75	7.52E-07
7.25	2.00E-07	3.25	1.74E-08	11.97	8.00E-07
7.12	1.92E-07	3.24	1.71E-08	12.18	8.41E-07
7.00	1.85E-07	3.23	1.67E-08	12.41	8.80E-07
6.87	1.75E-07	3.21	1.72E-08	12.63	9.42E-07
6.75	1.66E-07	3.20	1.58E-08	12.86	1.00E-06
6.63	1.60E-07	3.19	1.52E-08	13.09	1.07E-06
6.51	1.54E-07	3.18	1.56E-08	13.33	1.14E-06
6.39	1.47E-07	3.17	1.39E-08	13.57	1.20E-06
6.28	1.37E-07	3.16	1.28E-08	13.81	1.27E-06
6.17	1.32E-07	3.16	1.33E-08	14.06	1.35E-06
6.06	1.29E-07	3.15	1.40E-08	14.32	1.43E-06
5.95	1.24E-07	3.14	1.38E-08	14.58	1.52E-06
5.84	1.18E-07	3.13	1.31E-08	14.84	1.63E-06
5.74	1.13E-07	3.12	1.43E-08	15.10	1.74E-06
5.64	1.08E-07	3.11	1.46E-08	15.37	1.84E-06
5.53	1.01E-07	3.10	1.26E-08	15.65	1.94E-06
5.44	9.82E-08	3.09	1.15E-08	15.94	2.07E-06
5.34	9.34E-08	3.09	1.17E-08	16.23	2.18E-06
5.25	8.88E-08	3.08	1.12E-08	16.53	2.31E-06
5.15	8.57E-08	3.07	1.10E-08	16.83	2.47E-06
5.07	8.14E-08	3.06	1.21E-08	17.13	2.57E-06
4.98	7.73E-08	3.06	1.18E-08	17.44	2.70E-06
4.90	7.45E-08	3.05	1.12E-08	17.75	2.88E-06
4.83	7.15E-08	3.04	1.12E-08	18.07	3.01E-06
4.76	6.83E-08	3.04	1.16E-08	18.41	3.12E-06
4.69	6.59E-08	3.03	1.30E-08	18.74	3.33E-06
4.63	6.40E-08	3.02	1.18E-08	19.09	3.50E-06
4.57	6.22E-08	3.01	9.41E-09	19.43	3.62E-06
4.51	5.94E-08	3.01	8.91E-09	19.77	3.82E-06
4.46	5.72E-08	3.00	9.92E-09	20.13	4.05E-06
4.41	5.54E-08	3.00	1.03E-08	20.49	4.25E-06
4.36	5.30E-08	2.99	8.50E-09	20.87	4.42E-06
4.31	5.18E-08	2.99	7.31E-09	21.25	4.63E-06
4.27	4.95E-08	2.98	8.88E-09	21.63	4.86E-06
4.22	4.67E-08	2.97	9.40E-09	22.02	4.98E-06
4.18	4.70E-08	2.97	8.55E-09	22.42	5.14E-06
4.14	4.64E-08	2.96	8.14E-09	22.82	5.37E-06
4.10	4.32E-08	2.96	7.96E-09	23.24	5.57E-06

4.07	4.32E-08	2.95	8.91E-09	23.65	5.81E-06
4.03	4.41E-08	2.95	8.15E-09	24.09	6.02E-06
3.99	4.14E-08	2.94	6.48E-09	24.52	6.20E-06
3.96	3.92E-08	2.94	7.84E-09	24.96	6.43E-06
3.93	3.86E-08	2.94	8.74E-09	25.42	6.80E-06
3.90	3.75E-08	2.93	8.61E-09	25.87	7.06E-06
3.87	3.55E-08	2.92	9.08E-09	26.35	7.22E-06
3.84	3.49E-08	2.92	7.29E-09	26.82	7.56E-06
3.81	3.42E-08	2.91	7.63E-09	27.31	7.88E-06
3.79	3.29E-08	2.91	8.51E-09	27.80	8.03E-06
3.76	3.37E-08	2.90	7.63E-09	28.31	8.34E-06
3.73	3.31E-08	2.90	8.39E-09	28.82	8.78E-06
3.71	3.19E-08	2.89	9.48E-09	29.34	9.15E-06
3.68	3.15E-08	2.89	9.01E-09	29.88	9.45E-06
3.66	3.18E-08	2.88	6.64E-09	30.43	9.76E-06
3.64	2.88E-08	2.88	6.45E-09	30.99	1.04E-05
3.62	2.56E-08	2.88	8.01E-09	31.55	1.09E-05
3.60	2.52E-08	2.87	7.34E-09	32.12	1.12E-05
3.58	2.54E-08	2.87	5.90E-09	32.68	1.16E-05
3.56	2.67E-08	2.86	5.31E-09	33.28	1.21E-05
3.54	2.65E-08	2.86	6.64E-09	33.87	1.23E-05
3.52	2.60E-08	2.86	6.20E-09	34.49	1.27E-05
3.50	2.50E-08	2.85	6.12E-09	35.11	1.38E-05
3.48	2.35E-08	2.85	7.92E-09	35.75	1.48E-05
3.47	2.33E-08	2.84	7.75E-09	36.41	1.59E-05
3.45	2.33E-08	2.84	6.82E-09	37.07	1.71E-05
3.43	2.32E-08	2.84	6.15E-09	37.75	1.82E-05
3.42	2.27E-08	2.83	6.02E-09	38.42	1.96E-05
3.40	2.18E-08	2.83	6.39E-09	*39.12*	*2.12E-05*
3.39	2.08E-08	2.83	5.66E-09	*39.82*	*2.26E-05*
3.37	2.03E-08	2.82	6.31E-09	*40.56*	*2.42E-05*
3.36	2.03E-08	10.17	4.96E-07	*41.29*	*2.64E-05*
3.34	1.94E-08	10.36	5.18E-07	*42.05*	*2.92E-05*
3.33	1.80E-08	10.54	5.47E-07		

Table B20. Constant-R (decreasing then increasing ΔK) FCG data for specimen 42 L – T of D6AC Steel.

Specimen ID:	42			Orientation:	L-T
Test:	R = 0.3				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
10.50	5.39E-07	18.86	3.27E-06	38.71	1.76E-05
10.50	5.44E-07	19.43	3.59E-06	39.88	1.89E-05
10.50	5.39E-07	20.02	3.92E-06	41.10	2.02E-05
10.50	5.40E-07	20.64	4.25E-06	42.35	2.15E-05
10.58	5.47E-07	21.26	4.61E-06	43.64	2.31E-05
10.74	5.71E-07	21.91	5.00E-06	44.96	2.50E-05
10.98	6.15E-07	22.57	5.40E-06	46.32	2.72E-05
11.31	6.64E-07	23.25	5.78E-06	47.75	2.93E-05
11.66	7.13E-07	23.95	6.20E-06	49.20	3.15E-05
12.02	7.70E-07	24.67	6.68E-06	50.70	3.40E-05
12.38	8.34E-07	25.42	7.16E-06	52.26	3.72E-05
12.76	9.09E-07	26.21	7.68E-06	53.84	4.06E-05
13.14	9.97E-07	27.00	8.18E-06	55.46	4.44E-05
13.55	1.09E-06	27.83	8.70E-06	57.16	4.89E-05
13.96	1.19E-06	28.69	9.31E-06	58.86	5.32E-05
14.40	1.32E-06	29.56	9.90E-06	60.67	5.80E-05
14.84	1.46E-06	30.44	1.06E-05	62.48	6.39E-05
15.30	1.63E-06	31.37	1.13E-05	64.39	7.18E-05
15.76	1.80E-06	32.32	1.19E-05	66.32	8.08E-05
16.24	1.99E-06	33.29	1.26E-05	68.37	9.02E-05
16.73	2.21E-06	34.31	1.35E-05	70.44	1.02E-04
17.23	2.45E-06	35.35	1.43E-05	72.57	1.16E-04
17.75	2.70E-06	36.43	1.53E-05		
18.29	2.97E-06	37.56	1.64E-05		

Table B21. Constant-R (increasing ΔK) FCG data for specimen 43 L – T of D6AC Steel.

Specimen ID:	43			Orientation:	L-T
Test:	R = 0.8				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
5.02	9.31E-08	9.31	4.42E-07	16.22	2.38E-06
5.04	8.95E-08	9.47	4.63E-07	16.51	2.51E-06
5.04	9.27E-08	9.64	4.94E-07	16.80	2.67E-06
5.04	9.42E-08	9.82	5.31E-07	17.11	2.84E-06
5.04	9.32E-08	9.99	5.57E-07	17.42	3.02E-06
5.03	9.53E-08	8.11	2.94E-07	17.73	3.16E-06
5.03	9.40E-08	8.24	3.20E-07	18.03	3.58E-06
5.03	9.22E-08	8.39	3.44E-07	19.26	4.92E-06
5.03	9.38E-08	8.54	3.66E-07	19.30	4.94E-06
5.06	9.96E-08	8.69	3.74E-07	19.33	4.95E-06
5.10	9.95E-08	8.85	3.82E-07	19.39	4.57E-06
5.17	9.53E-08	9.01	4.08E-07	19.47	4.71E-06
5.26	9.64E-08	9.17	4.28E-07	19.56	4.86E-06
5.36	9.93E-08	9.34	4.41E-07	19.68	4.78E-06
5.45	1.09E-07	9.51	4.76E-07	19.80	4.88E-06
5.55	1.18E-07	9.68	5.18E-07	19.92	5.00E-06
5.65	1.22E-07	9.85	5.37E-07	20.04	4.84E-06
5.75	1.27E-07	10.03	5.49E-07	20.16	5.02E-06
5.86	1.36E-07	10.21	5.78E-07	20.27	5.09E-06
5.96	1.41E-07	10.39	6.15E-07	20.40	4.96E-06
6.07	1.48E-07	10.58	6.47E-07	20.52	5.03E-06
6.18	1.53E-07	10.77	6.80E-07	20.64	5.06E-06
6.29	1.58E-07	10.97	7.25E-07	20.77	5.23E-06
6.40	1.65E-07	11.16	7.63E-07	20.89	5.50E-06
6.52	1.70E-07	11.36	7.87E-07	21.02	5.67E-06
6.64	1.78E-07	11.57	8.34E-07	21.14	5.70E-06
6.76	1.92E-07	11.77	8.89E-07	21.27	5.73E-06
6.88	2.01E-07	11.98	9.32E-07	21.40	5.65E-06
7.00	2.07E-07	12.20	9.76E-07	21.53	5.66E-06
7.13	2.21E-07	12.42	1.05E-06	21.66	5.97E-06
7.26	2.32E-07	12.65	1.12E-06	21.79	6.16E-06
7.39	2.38E-07	12.88	1.16E-06	21.92	6.08E-06
7.52	2.50E-07	13.10	1.22E-06	22.05	6.26E-06
7.65	2.58E-07	13.34	1.30E-06	22.19	6.53E-06
7.79	2.64E-07	13.57	1.37E-06	22.32	6.54E-06
7.93	2.82E-07	13.82	1.43E-06	22.45	6.56E-06
8.07	3.00E-07	14.06	1.53E-06	22.58	6.59E-06
8.21	3.18E-07	14.31	1.66E-06	22.72	6.80E-06
8.36	3.34E-07	14.57	1.75E-06	22.86	7.04E-06
8.51	3.51E-07	14.83	1.82E-06	22.99	6.97E-06
8.66	3.69E-07	15.10	1.92E-06	23.14	7.33E-06
8.82	3.84E-07	15.37	2.04E-06	23.27	7.59E-06
8.98	4.03E-07	15.65	2.19E-06	23.41	7.59E-06
9.15	4.22E-07	15.93	2.31E-06	23.55	7.95E-06

Table B22. Constant-R (increasing ΔK) FCG data for specimen 44 L – T of D6AC Steel.

Specimen ID:	44			Orientation:	L-T
Test:	R = 0.8				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
14.95	2.02E-06	16.45	2.57E-06	18.83	3.87E-06
15.07	2.05E-06	16.90	2.79E-06	19.34	4.28E-06
15.27	2.10E-06	17.36	3.02E-06	19.87	5.17E-06
15.59	2.21E-06	17.84	3.26E-06	20.42	5.24E-06
16.01	2.38E-06	18.32	3.54E-06	21.00	7.60E-06

Table B23. Constant-R (decreasing then increasing ΔK) FCG data for specimen 45 L – T of D6AC Steel.

Specimen ID:	45			Orientation:	L-T
Test:	R = 0.3				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
14.21	9.99E-07	4.72	4.21E-08	19.28	2.93E-06
14.13	9.87E-07	4.68	3.85E-08	19.63	3.09E-06
14.00	9.67E-07	4.64	3.59E-08	19.98	3.27E-06
13.79	9.36E-07	4.61	3.48E-08	20.35	3.44E-06
13.54	8.96E-07	4.58	3.45E-08	20.73	3.62E-06
13.30	8.54E-07	4.55	3.44E-08	21.11	3.80E-06
13.06	8.06E-07	4.52	3.34E-08	21.51	4.01E-06
12.83	7.68E-07	4.48	3.17E-08	21.89	4.21E-06
12.60	7.34E-07	4.46	2.83E-08	22.29	4.38E-06
12.38	7.01E-07	4.43	2.41E-08	22.69	4.59E-06
12.16	6.72E-07	4.41	2.01E-08	23.09	4.82E-06
11.94	6.40E-07	4.40	1.71E-08	23.53	5.05E-06
11.73	6.13E-07	4.38	1.50E-08	23.95	5.25E-06
11.52	5.87E-07	4.37	1.37E-08	24.40	5.49E-06
11.31	5.61E-07	4.36	1.33E-08	24.84	5.76E-06
11.11	5.37E-07	4.35	1.27E-08	25.29	6.00E-06
10.91	5.11E-07	4.34	1.26E-08	25.76	6.25E-06
10.72	4.87E-07	4.33	1.25E-08	26.23	6.51E-06
10.52	4.64E-07	4.31	1.27E-08	26.72	6.79E-06
10.34	4.43E-07	4.30	1.29E-08	27.20	7.07E-06
10.15	4.23E-07	4.29	1.29E-08	27.70	7.32E-06
9.97	4.06E-07	4.28	1.29E-08	28.21	7.64E-06
9.79	3.88E-07	4.27	1.28E-08	28.72	7.91E-06
9.62	3.70E-07	4.26	1.26E-08	29.25	8.22E-06
9.45	3.53E-07	4.25	1.23E-08	29.78	8.50E-06
9.28	3.38E-07	4.24	1.16E-08	30.34	8.75E-06
9.11	3.22E-07	4.23	1.11E-08	30.89	9.05E-06
8.95	3.07E-07	4.22	1.01E-08	31.46	9.34E-06
8.79	2.93E-07	4.21	9.42E-09	32.03	9.81E-06
8.63	2.79E-07	4.20	8.73E-09	32.61	1.02E-05
8.48	2.65E-07	4.20	8.20E-09	33.21	1.06E-05

8.33	2.53E-07	4.19	7.69E-09	33.80	1.10E-05
8.18	2.41E-07	4.18	7.18E-09	34.41	1.14E-05
8.03	2.30E-07	4.18	7.13E-09	35.05	1.17E-05
7.89	2.19E-07	4.17	7.29E-09	35.67	1.21E-05
7.75	2.09E-07	4.16	8.20E-09	36.33	1.26E-05
7.61	1.99E-07	4.16	7.30E-09	36.98	1.31E-05
7.47	1.90E-07	4.15	7.14E-09	37.67	1.35E-05
7.34	1.81E-07	11.38	6.02E-07	38.36	1.39E-05
7.21	1.74E-07	11.59	6.25E-07	39.06	1.44E-05
7.08	1.67E-07	11.80	6.51E-07	39.77	1.49E-05
6.95	1.60E-07	12.03	6.82E-07	40.50	1.56E-05
6.83	1.53E-07	12.24	7.13E-07	41.24	1.62E-05
6.71	1.45E-07	12.47	7.47E-07	42.01	1.69E-05
6.59	1.38E-07	12.69	7.83E-07	42.77	1.75E-05
6.47	1.30E-07	12.93	8.16E-07	43.54	1.90E-05
6.36	1.23E-07	13.17	8.51E-07	44.33	2.05E-05
6.24	1.17E-07	13.41	8.87E-07	45.49	2.20E-05
6.13	1.11E-07	13.66	9.36E-07	45.97	2.33E-05
6.02	1.05E-07	13.91	9.89E-07	47.17	2.44E-05
5.91	9.91E-08	14.17	1.05E-06	47.68	2.55E-05
5.81	9.36E-08	14.43	1.11E-06	48.55	2.61E-05
5.71	8.81E-08	14.70	1.18E-06	49.43	2.73E-05
5.61	8.27E-08	14.97	1.24E-06	50.35	2.86E-05
5.52	7.70E-08	15.23	1.32E-06	51.28	3.00E-05
5.43	7.17E-08	15.51	1.41E-06	52.22	3.15E-05
5.36	6.66E-08	15.80	1.51E-06	53.17	3.30E-05
5.29	6.22E-08	16.08	1.61E-06	54.14	3.46E-05
5.22	6.02E-08	16.37	1.70E-06	55.13	3.64E-05
5.17	6.04E-08	16.66	1.81E-06	56.13	3.83E-05
5.10	6.12E-08	16.97	1.93E-06	57.15	4.03E-05
5.04	6.17E-08	17.29	2.05E-06	58.16	4.25E-05
4.98	6.08E-08	17.61	2.19E-06	59.22	4.48E-05
4.91	5.84E-08	17.94	2.33E-06	60.31	4.77E-05
4.86	5.47E-08	18.28	2.47E-06	61.42	4.98E-05
4.81	5.04E-08	18.61	2.61E-06		
4.76	4.63E-08	18.95	2.78E-06		

Table B24. Constant-R (increasing ΔK) FCG data for specimen 46 L – T of D6AC Steel.

Specimen ID:	46			Orientation:	L-T
Test:	R = 0.1				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
10.58	4.82E-07	23.14	4.77E-06	56.05	3.54E-05
10.58	4.90E-07	23.55	5.09E-06	57.07	3.76E-05
10.66	5.15E-07	23.97	5.45E-06	58.11	3.99E-05
10.79	5.43E-07	24.42	5.59E-06	59.17	4.16E-05
10.97	5.72E-07	24.87	5.91E-06	60.27	4.33E-05
11.21	6.14E-07	25.33	6.32E-06	61.38	4.57E-05
11.40	6.32E-07	25.80	6.65E-06	62.51	4.82E-05
11.62	6.51E-07	26.26	6.90E-06	63.67	5.11E-05
11.83	6.90E-07	26.74	7.21E-06	64.79	5.27E-05
12.05	7.35E-07	27.22	7.54E-06	65.96	5.53E-05
12.27	7.73E-07	27.72	7.77E-06	67.13	5.95E-05
12.49	8.13E-07	28.23	8.11E-06	68.34	6.23E-05
12.72	8.52E-07	28.74	8.31E-06	69.60	6.51E-05
12.96	8.81E-07	29.27	8.72E-06	70.89	6.85E-05
13.19	9.37E-07	29.78	9.06E-06	72.18	7.15E-05
13.44	9.97E-07	30.32	9.36E-06	73.52	7.58E-05
13.68	1.02E-06	30.87	9.76E-06	74.86	8.17E-05
13.94	1.07E-06	31.44	1.00E-05	76.20	8.77E-05
14.20	1.13E-06	32.02	1.05E-05	77.62	9.41E-05
14.47	1.15E-06	32.62	1.08E-05	79.02	1.00E-04
14.73	1.22E-06	33.22	1.11E-05	80.46	1.07E-04
14.99	1.29E-06	33.82	1.16E-05	81.94	1.15E-04
15.26	1.29E-06	34.44	1.21E-05	83.43	1.23E-04
15.54	1.34E-06	35.06	1.25E-05	84.92	1.30E-04
15.82	1.43E-06	35.70	1.30E-05	86.46	1.38E-04
16.11	1.49E-06	36.34	1.37E-05	88.03	1.50E-04
16.40	1.58E-06	36.99	1.39E-05	89.48	1.60E-04
16.70	1.67E-06	37.66	1.44E-05	91.27	1.88E-04
17.02	1.78E-06	38.35	1.51E-05	92.81	1.99E-04
17.33	1.90E-06	39.05	1.56E-05	94.63	1.93E-04
17.65	1.99E-06	39.77	1.61E-05	96.39	2.02E-04
17.98	2.14E-06	40.49	1.68E-05	98.17	2.14E-04
18.30	2.29E-06	41.23	1.74E-05	99.92	2.27E-04
18.64	2.41E-06	41.99	1.82E-05	101.76	2.42E-04
18.97	2.57E-06	42.76	1.90E-05	103.59	2.62E-04
19.31	2.74E-06	43.54	1.98E-05	105.49	2.86E-04
19.66	2.94E-06	47.66	2.38E-05	107.38	3.16E-04
20.02	3.12E-06	48.50	2.41E-05	109.35	3.37E-04
20.39	3.29E-06	49.37	2.52E-05	111.31	3.51E-04
20.76	3.45E-06	50.28	2.65E-05	113.33	3.80E-04
21.14	3.66E-06	51.20	2.78E-05	115.41	4.07E-04
21.53	3.89E-06	52.14	2.91E-05	117.53	4.42E-04
21.92	4.11E-06	53.10	3.09E-05	119.74	4.85E-04
22.33	4.40E-06	54.06	3.23E-05	*122.07*	*5.45E-04*

22.74	4.63E-06	55.05	3.36E-05

Table B25. Constant-R (increasing ΔK) FCG data for specimen 47 L – T of D6AC Steel.

Specimen ID:	47			Orientation:	L-T
Test:	R = 0.8				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
15.00	1.92E-06	22.31	6.14E-06	32.60	2.76E-05
15.08	1.94E-06	22.54	6.26E-06	32.93	2.98E-05
15.19	2.05E-06	22.77	6.35E-06	33.25	3.23E-05
15.35	2.07E-06	23.00	6.49E-06	33.58	3.53E-05
15.51	2.12E-06	23.23	6.68E-06	33.91	3.97E-05
15.66	2.20E-06	23.47	6.91E-06	34.00	3.51E-05
15.82	2.26E-06	23.70	7.13E-06	30.85	1.43E-05
15.98	2.33E-06	23.94	7.36E-06	31.16	1.54E-05
16.13	2.41E-06	24.18	7.54E-06	31.47	1.66E-05
16.30	2.48E-06	24.43	7.66E-06	31.79	1.80E-05
16.47	2.57E-06	24.68	7.92E-06	32.11	1.96E-05
16.64	2.66E-06	24.93	8.27E-06	32.44	2.12E-05
16.81	2.74E-06	25.19	8.55E-06	32.76	2.30E-05
16.99	2.80E-06	25.44	8.78E-06	33.09	2.48E-05
17.15	2.88E-06	25.70	9.01E-06	33.42	2.72E-05
17.33	2.94E-06	25.95	9.25E-06	33.75	3.02E-05
17.50	3.01E-06	26.21	9.56E-06	34.09	3.33E-05
17.68	3.09E-06	26.48	1.01E-05	34.43	3.58E-05
17.86	3.18E-06	26.74	1.09E-05	34.78	3.78E-05
18.04	3.29E-06	27.01	1.16E-05	35.12	4.00E-05
18.22	3.39E-06	27.29	1.21E-05	35.48	4.21E-05
18.41	3.47E-06	27.55	1.26E-05	35.84	4.46E-05
18.60	3.56E-06	27.83	1.30E-05	*36.21*	*4.78E-05*
18.79	3.66E-06	28.11	1.32E-05	*36.58*	*5.10E-05*
18.98	3.74E-06	28.38	1.35E-05	*36.94*	*5.39E-05*
19.17	3.84E-06	28.68	1.39E-05	*37.31*	*5.69E-05*
19.36	3.96E-06	28.97	1.45E-05	*37.67*	*6.06E-05*
19.56	4.10E-06	29.26	1.58E-05	*38.05*	*6.58E-05*
19.76	4.24E-06	29.55	1.71E-05	*38.43*	*7.13E-05*
19.96	4.39E-06	29.83	1.48E-05	*38.82*	*7.69E-05*
20.17	4.52E-06	29.99	2.03E-05	*39.21*	*8.41E-05*
20.37	4.63E-06	30.15	1.90E-05	*39.61*	*9.36E-05*
20.58	4.75E-06	30.26	2.47E-05	*40.00*	*1.06E-04*
20.79	4.88E-06	30.44	3.18E-05	*40.39*	*1.21E-04*
20.99	5.03E-06	30.68	2.18E-05	*40.79*	*1.38E-04*
21.20	5.19E-06	30.99	2.02E-05	*41.21*	*1.59E-04*
21.42	5.39E-06	31.30	2.11E-05	*41.62*	*1.73E-04*
21.63	5.59E-06	31.61	2.23E-05	*42.04*	*2.04E-04*
21.86	5.78E-06	31.94	2.37E-05		
22.08	5.97E-06	32.26	2.56E-05		

Table B26. Constant-R (increasing ΔK) FCG data for specimen 48 L – T of D6AC Steel.

Specimen ID:	48			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
19.94	3.97E-06	28.64	9.49E-06	41.44	2.63E-05
20.04	4.01E-06	28.93	9.70E-06	41.86	2.78E-05
20.19	4.09E-06	29.21	9.90E-06	42.29	2.94E-05
20.39	4.20E-06	29.51	1.01E-05	42.71	3.08E-05
20.59	4.35E-06	29.81	1.03E-05	43.14	3.22E-05
20.80	4.47E-06	30.11	1.06E-05	43.56	3.36E-05
21.00	4.59E-06	30.41	1.08E-05	44.00	3.50E-05
21.21	4.71E-06	30.71	1.11E-05	44.43	3.63E-05
21.43	4.84E-06	31.02	1.14E-05	44.88	3.77E-05
21.64	4.97E-06	31.33	1.18E-05	45.33	3.88E-05
21.86	5.10E-06	31.65	1.21E-05	45.80	4.03E-05
22.08	5.24E-06	31.96	1.23E-05	46.26	4.22E-05
22.31	5.36E-06	32.28	1.26E-05	46.73	4.50E-05
22.53	5.48E-06	32.61	1.29E-05	47.19	4.90E-05
22.76	5.63E-06	32.93	1.32E-05	47.67	5.42E-05
22.99	5.78E-06	33.26	1.35E-05	48.15	5.97E-05
23.22	5.91E-06	33.60	1.39E-05	48.64	6.33E-05
23.45	6.05E-06	33.93	1.42E-05	49.13	6.56E-05
23.69	6.19E-06	34.28	1.45E-05	49.62	6.79E-05
23.92	6.33E-06	34.62	1.48E-05	50.10	6.89E-05
24.16	6.47E-06	34.97	1.52E-05	50.60	6.93E-05
24.41	6.62E-06	35.32	1.57E-05	51.11	7.15E-05
24.65	6.78E-06	35.67	1.63E-05	51.63	7.56E-05
24.90	6.96E-06	36.03	1.67E-05	52.15	8.23E-05
25.15	7.12E-06	36.39	1.69E-05	52.68	9.16E-05
25.40	7.28E-06	36.76	1.70E-05	53.21	1.02E-04
25.66	7.45E-06	37.13	1.72E-05	53.73	1.12E-04
25.91	7.63E-06	37.50	1.75E-05	54.27	1.23E-04
26.17	7.82E-06	37.88	1.81E-05	54.81	1.33E-04
26.44	8.00E-06	38.25	1.88E-05	*55.35*	*1.43E-04*
26.71	8.20E-06	38.65	1.95E-05	*55.90*	*1.51E-04*
26.97	8.39E-06	39.03	2.00E-05	*56.47*	*1.57E-04*
27.24	8.55E-06	39.43	2.06E-05	*57.03*	*1.64E-04*
27.51	8.77E-06	39.81	2.14E-05	*57.61*	*1.75E-04*
27.79	8.97E-06	40.22	2.23E-05	*58.18*	*1.91E-04*
28.07	9.12E-06	40.61	2.36E-05	*58.75*	*2.09E-04*
28.35	9.29E-06	41.03	2.50E-05	*59.22*	*2.38E-04*

Table B27. Constant-R (decreasing then increasing ΔK) FCG data for specimen 2 – T-L of D6AC Steel.

Specimen ID:	2			Orientation:	T-L
Test:	R = 0.7				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
10.15	3.50E-07	3.82	2.34E-08	13.25	7.05E-07
10.15	3.53E-07	3.80	2.21E-08	13.47	7.45E-07
10.10	3.52E-07	3.78	2.13E-08	13.70	7.77E-07
10.00	3.45E-07	3.77	2.14E-08	13.92	8.24E-07
9.86	3.32E-07	3.75	2.09E-08	14.15	8.72E-07
9.68	3.19E-07	3.73	2.03E-08	14.39	9.05E-07
9.51	3.04E-07	3.72	2.06E-08	14.63	9.37E-07
9.34	2.86E-07	3.70	2.01E-08	14.88	1.00E-06
9.17	2.76E-07	3.69	1.91E-08	15.12	1.06E-06
9.00	2.61E-07	3.67	1.85E-08	15.38	1.13E-06
8.84	2.48E-07	3.66	1.82E-08	15.63	1.21E-06
8.68	2.35E-07	3.64	1.68E-08	15.89	1.26E-06
8.52	2.22E-07	3.63	1.63E-08	16.15	1.33E-06
8.37	2.12E-07	3.62	1.72E-08	16.42	1.43E-06
8.22	2.04E-07	3.61	1.67E-08	16.70	1.55E-06
8.07	1.99E-07	3.59	1.58E-08	16.97	1.56E-06
7.93	1.88E-07	3.58	1.44E-08	17.26	1.62E-06
7.78	1.78E-07	3.57	1.45E-08	17.53	1.82E-06
7.64	1.73E-07	3.56	1.57E-08	17.83	1.99E-06
7.50	1.63E-07	3.55	1.71E-08	18.12	2.05E-06
7.37	1.51E-07	3.54	1.56E-08	18.42	2.04E-06
7.24	1.47E-07	3.52	1.36E-08	18.72	2.20E-06
7.11	1.47E-07	3.51	1.31E-08	19.01	2.32E-06
6.98	1.41E-07	3.50	1.19E-08	19.32	2.44E-06
6.85	1.33E-07	3.50	1.19E-08	19.64	2.65E-06
6.74	1.25E-07	3.49	1.34E-08	19.98	2.76E-06
6.61	1.18E-07	3.48	1.46E-08	20.32	2.88E-06
6.50	1.11E-07	3.47	1.43E-08	20.65	2.99E-06
6.38	1.03E-07	3.46	1.29E-08	20.99	3.10E-06
6.27	1.02E-07	3.45	1.24E-08	21.34	3.50E-06
6.15	9.80E-08	3.44	1.27E-08	21.67	3.58E-06
6.04	9.45E-08	3.43	1.28E-08	22.05	3.72E-06
5.93	9.14E-08	3.42	1.28E-08	22.38	3.87E-06
5.83	8.80E-08	3.41	1.16E-08	22.76	3.74E-06
5.72	8.69E-08	3.40	1.15E-08	23.13	3.97E-06
5.63	8.48E-08	3.39	1.23E-08	23.51	4.31E-06
5.25	7.58E-08	3.38	1.21E-08	23.90	4.67E-06
5.17	7.10E-08	3.38	1.16E-08	24.28	4.72E-06
5.09	6.44E-08	3.37	1.12E-08	24.68	4.96E-06
5.02	5.98E-08	3.36	1.01E-08	25.09	5.38E-06
4.96	5.38E-08	3.35	1.08E-08	25.49	5.28E-06
4.91	4.73E-08	3.35	1.08E-08	25.93	5.50E-06
4.86	4.36E-08	3.34	1.14E-08	26.34	5.96E-06
4.82	4.12E-08	3.33	1.23E-08	26.79	6.14E-06

4.77	4.15E-08	3.32	8.66E-09	27.22	6.39E-06
4.73	4.45E-08	3.32	7.40E-09	27.66	6.68E-06
4.69	4.53E-08	3.31	9.48E-09	28.10	7.01E-06
4.64	4.75E-08	3.30	1.16E-08	28.56	7.22E-06
4.60	4.90E-08	3.30	1.21E-08	29.01	7.47E-06
4.55	4.70E-08	3.29	8.74E-09	29.50	7.91E-06
4.51	4.46E-08	3.28	8.69E-09	29.98	8.34E-06
4.46	4.38E-08	3.28	8.58E-09	30.46	8.26E-06
4.43	4.18E-08	3.27	7.39E-09	30.97	8.44E-06
4.39	4.03E-08	3.26	8.86E-09	31.45	9.26E-06
4.35	3.95E-08	3.26	8.43E-09	31.97	9.98E-06
4.31	3.80E-08	3.25	8.42E-09	32.48	1.00E-05
4.28	3.59E-08	3.25	9.16E-09	33.00	1.08E-05
4.25	3.61E-08	3.24	9.03E-09	33.51	1.14E-05
4.22	3.73E-08	3.23	8.42E-09	34.08	1.21E-05
4.18	3.45E-08	3.23	8.70E-09	34.60	1.28E-05
4.15	3.30E-08	3.22	9.35E-09	35.19	1.24E-05
4.12	3.41E-08	3.22	6.96E-09	35.77	1.34E-05
4.10	3.43E-08	3.21	5.94E-09	36.34	1.51E-05
4.07	3.20E-08	11.03	4.38E-07	36.93	1.52E-05
4.04	3.02E-08	11.21	4.46E-07	37.52	1.54E-05
4.01	3.02E-08	11.40	4.71E-07	38.11	1.74E-05
3.99	2.94E-08	11.59	4.85E-07	*38.74*	*1.88E-05*
3.97	2.62E-08	11.79	5.11E-07	*39.35*	*1.91E-05*
3.94	2.51E-08	11.99	5.34E-07	*40.00*	*2.14E-05*
3.92	2.63E-08	12.19	5.54E-07	*40.63*	*2.54E-05*
3.90	2.60E-08	12.40	5.72E-07	*41.30*	*2.71E-05*
3.88	2.49E-08	12.61	6.03E-07	*41.96*	*3.01E-05*
3.86	2.46E-08	12.82	6.30E-07	*42.64*	*3.73E-05*
3.84	2.46E-08	13.03	6.53E-07	*43.30*	*4.60E-05*

Table B28. Constant-K_{max} FCG data for specimen 5 – T-L of D6AC Steel.

Specimen ID:	5			Orientation:	T-L
Test:	K_{max} = 15 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
13.08	8.07E-07	7.88	2.44E-07	4.74	6.69E-08
12.84	8.05E-07	7.73	2.26E-07	4.66	6.46E-08
12.61	7.80E-07	7.59	2.17E-07	4.58	6.51E-08
12.38	7.56E-07	7.46	2.15E-07	4.49	6.21E-08
12.16	7.25E-07	7.32	2.07E-07	4.41	5.85E-08
11.94	6.91E-07	7.19	1.98E-07	4.33	5.77E-08
11.73	6.59E-07	7.07	1.88E-07	4.25	5.46E-08
11.52	6.33E-07	6.94	1.76E-07	4.18	4.76E-08
11.31	6.07E-07	6.82	1.68E-07	4.10	4.49E-08
11.11	5.78E-07	6.69	1.66E-07	4.03	4.43E-08
10.91	5.52E-07	6.57	1.59E-07	3.96	3.94E-08
10.71	5.27E-07	6.45	1.51E-07	3.88	3.74E-08
10.52	5.02E-07	6.34	1.42E-07	3.82	3.88E-08
10.33	4.83E-07	6.22	1.32E-07	3.74	3.82E-08
10.15	4.67E-07	6.11	1.27E-07	3.68	3.52E-08
9.97	4.49E-07	6.00	1.25E-07	3.61	3.08E-08
9.79	4.30E-07	5.89	1.20E-07	3.54	2.87E-08
9.61	4.12E-07	5.79	1.15E-07	3.48	2.80E-08
9.44	3.94E-07	5.68	1.09E-07	3.42	2.57E-08
9.27	3.74E-07	5.58	1.04E-07	3.36	2.40E-08
9.10	3.54E-07	5.48	9.80E-08	3.30	2.17E-08
8.94	3.35E-07	5.38	9.65E-08	3.24	1.90E-08
8.78	3.20E-07	5.29	9.59E-08	3.18	1.54E-08
8.62	3.07E-07	5.19	8.91E-08	3.12	1.51E-08
8.47	2.91E-07	5.10	8.20E-08	3.07	1.61E-08
8.32	2.79E-07	5.01	7.83E-08	3.01	1.10E-08
8.17	2.69E-07	4.92	7.61E-08	2.96	8.79E-09
8.02	2.56E-07	4.83	7.27E-08		

Table B29. Constant-K_{max} FCG data for specimen 8 – T-L of D6AC Steel.

Specimen ID:	8			Orientation:	T-L
Test:	K_{max} = 30 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
20.08	3.32E-06	6.05	1.31E-07	3.03	1.55E-08
19.50	3.25E-06	5.78	1.26E-07	3.01	1.49E-08
19.43	2.98E-06	5.52	1.09E-07	2.98	1.48E-08
18.42	2.68E-06	5.27	9.67E-08	2.96	1.38E-08
17.95	2.41E-06	5.04	8.86E-08	2.94	1.39E-08
17.14	2.13E-06	4.83	8.16E-08	2.90	1.33E-08
16.39	1.89E-06	4.63	7.44E-08	2.86	1.16E-08
15.65	1.63E-06	4.47	6.58E-08	2.85	1.09E-08
14.96	1.40E-06	4.32	5.77E-08	2.83	1.05E-08
14.30	1.20E-06	4.19	5.31E-08	2.77	1.01E-08
13.66	1.04E-06	4.08	4.92E-08	2.74	8.71E-09
13.06	9.19E-07	3.98	4.71E-08	2.71	8.01E-09
12.49	7.86E-07	3.88	4.78E-08	2.68	7.58E-09
11.93	6.93E-07	3.79	4.49E-08	2.67	7.61E-09
11.41	6.34E-07	3.70	4.09E-08	2.66	6.84E-09
10.90	5.45E-07	3.63	3.73E-08	2.65	6.75E-09
10.41	4.83E-07	3.56	3.36E-08	2.61	6.53E-09
9.96	4.36E-07	3.50	3.23E-08	2.58	6.51E-09
9.52	3.77E-07	3.44	3.04E-08	2.57	5.43E-09
9.10	3.43E-07	3.39	2.77E-08	2.55	5.86E-09
8.69	3.17E-07	3.35	2.57E-08	2.53	4.71E-09
8.30	2.82E-07	3.30	2.45E-08	2.51	3.04E-09
7.94	2.43E-07	3.26	2.37E-08	2.51	1.22E-09
7.58	2.21E-07	3.22	2.20E-08	2.50	4.24E-09
7.25	2.02E-07	3.18	2.18E-08	2.50	4.90E-09
6.92	1.80E-07	3.15	2.00E-08	2.49	4.13E-09
6.62	1.64E-07	3.09	1.84E-08	2.49	3.14E-09
6.33	1.41E-07	3.06	1.77E-08		

Table B30. Constant-R (increasing ΔK) FCG data for specimen 14 – T-L of D6AC Steel.

Specimen ID:	14			Orientation:	T-L
Test:	R = 0.8				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
10.11	5.91E-07	14.67	1.63E-06	22.33	6.22E-06
10.14	5.90E-07	15.06	1.78E-06	22.93	6.61E-06
10.27	5.95E-07	15.45	1.94E-06	23.54	7.06E-06
10.44	6.13E-07	15.86	2.10E-06	24.18	7.81E-06
10.71	6.44E-07	16.30	2.28E-06	24.81	9.18E-06
11.00	6.89E-07	16.73	2.48E-06	25.49	1.12E-05
11.29	7.43E-07	17.18	2.68E-06	26.17	1.38E-05
11.59	8.01E-07	17.64	2.91E-06	26.86	1.67E-05
11.89	8.62E-07	18.11	3.18E-06	27.59	1.98E-05
12.21	9.29E-07	18.59	3.50E-06	28.32	2.39E-05
12.54	1.00E-06	19.09	3.84E-06	29.06	2.94E-05
12.87	1.08E-06	19.59	4.21E-06	29.86	3.68E-05
13.21	1.16E-06	20.12	4.60E-06	30.63	4.81E-05
13.56	1.26E-06	20.65	5.03E-06	31.42	6.29E-05
13.92	1.37E-06	21.19	5.45E-06	32.25	7.54E-05
14.29	1.50E-06	21.76	5.84E-06	33.07	9.49E-05

Table B31. Constant-R (increasing ΔK) FCG data for specimen 15 – T-L of D6AC Steel.

Specimen ID:	15			Orientation:	T-L
Test:	R = 0.9				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
6.17	1.87E-07	9.17	5.49E-07	13.60	3.57E-06
6.32	1.99E-07	9.41	5.93E-07	13.96	4.67E-06
6.49	2.13E-07	9.67	6.47E-07	14.36	6.19E-06
6.67	2.29E-07	9.92	7.14E-07	14.73	8.24E-06
6.85	2.46E-07	10.18	7.82E-07	15.15	1.07E-05
7.03	2.64E-07	10.45	8.54E-07	15.55	1.39E-05
7.22	2.83E-07	10.72	9.41E-07	15.94	1.74E-05
7.42	3.03E-07	11.02	1.05E-06	16.39	2.11E-05
7.62	3.23E-07	11.32	1.17E-06	16.80	2.71E-05
7.82	3.48E-07	11.62	1.34E-06	17.25	3.89E-05
8.03	3.74E-07	11.94	1.55E-06	17.70	5.52E-05
8.24	4.03E-07	12.26	1.79E-06	18.22	8.81E-05
8.46	4.36E-07	12.58	2.08E-06	18.70	2.04E-04
8.69	4.71E-07	12.91	2.41E-06		
8.92	5.09E-07	13.25	2.84E-06		

Table B32. Constant-K_{max} FCG data for specimen 15 – T-L of D6AC Steel.

Specimen ID:	15			Orientation:	T-L
Test:	K_{max} = 20 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
10.03	6.06E-07	2.97	1.71E-08	2.37	1.97E-09
9.17	4.84E-07	2.87	1.45E-08	2.36	2.13E-09
8.38	3.89E-07	2.78	1.22E-08	2.35	2.34E-09
7.65	3.14E-07	2.72	1.03E-08	2.34	2.34E-09
6.98	2.52E-07	2.66	8.57E-09	2.32	2.16E-09
6.37	2.03E-07	2.61	7.26E-09	2.31	1.84E-09
5.82	1.62E-07	2.58	6.28E-09	2.30	1.46E-09
5.31	1.32E-07	2.55	5.70E-09	2.30	1.10E-09
4.85	1.05E-07	2.52	5.50E-09	2.29	9.77E-10
4.44	8.04E-08	2.49	5.38E-09	2.29	1.06E-09
4.05	5.88E-08	2.45	4.97E-09	2.28	1.33E-09
3.73	4.28E-08	2.43	4.23E-09	2.28	1.48E-09
3.45	3.22E-08	2.41	3.48E-09	2.27	1.33E-09
3.24	2.54E-08	2.39	2.78E-09	2.26	1.09E-09
3.09	2.04E-08	2.38	2.18E-09		

Table B33. Constant-R (decreasing ΔK) FCG data for specimen 1 – S-T of D6AC Steel.

Specimen ID:	1			Orientation:	S-T
Test:	R = 0.1				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
11.92	3.04E-07	9.36	1.56E-07	7.47	5.19E-08
11.58	2.91E-07	9.09	1.35E-07	7.32	4.88E-08
11.20	2.99E-07	8.82	1.30E-07	7.20	3.87E-08
10.87	2.56E-07	8.56	1.03E-07	7.09	3.32E-08
10.56	2.45E-07	8.31	8.94E-08	7.01	2.35E-08
10.25	2.40E-07	8.06	8.12E-08	6.96	1.63E-08
9.94	2.37E-07	7.83	6.93E-08		
9.64	1.86E-07	7.63	5.66E-08		

Table B34. Constant-R (decreasing then increasing ΔK) FCG data for specimen 3 – S-T of D6AC Steel.

Specimen ID:	3			Orientation:	S-T
Test:	R = 0.3				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
13.06	7.72E-07	7.35	1.65E-07	26.32	8.01E-06
12.75	7.92E-07	7.22	1.55E-07	27.56	8.84E-06
12.53	8.52E-07	7.09	1.44E-07	28.83	9.70E-06
12.31	8.37E-07	6.96	1.31E-07	30.17	1.07E-05
12.09	7.99E-07	6.84	1.17E-07	31.55	1.17E-05
11.88	7.65E-07	6.72	1.06E-07	33.04	1.28E-05
11.67	7.32E-07	6.60	9.69E-08	34.55	1.41E-05
11.46	6.97E-07	6.49	8.97E-08	36.16	1.55E-05
11.25	6.67E-07	6.37	8.27E-08	37.82	1.70E-05
11.06	6.44E-07	6.26	7.57E-08	39.55	1.87E-05
10.87	6.17E-07	6.15	6.89E-08	41.39	2.08E-05
10.68	5.88E-07	6.04	6.24E-08	43.29	2.30E-05
10.49	5.58E-07	5.93	5.68E-08	45.32	2.57E-05
10.30	5.29E-07	5.83	5.15E-08	47.40	2.87E-05
10.13	5.02E-07	5.72	4.67E-08	49.64	3.22E-05
9.95	4.80E-07	5.62	4.21E-08	51.94	3.65E-05
9.77	4.62E-07	5.52	3.77E-08	54.39	4.18E-05
9.60	4.42E-07	5.43	3.37E-08	56.85	4.81E-05
9.43	4.22E-07	5.33	3.02E-08	59.52	5.51E-05
9.26	4.03E-07	5.24	2.68E-08	62.20	6.34E-05
9.10	3.83E-07	5.14	2.30E-08	65.07	7.38E-05
8.94	3.64E-07	5.05	1.94E-08	68.07	8.64E-05
8.78	3.41E-07	4.96	1.73E-08	71.26	1.02E-04
8.62	3.09E-07	4.88	2.08E-08	74.40	1.23E-04
8.42	2.81E-07	4.71	4.47E-09	77.86	1.46E-04
8.32	2.56E-07	19.16	3.50E-06	81.31	1.77E-04
8.12	2.40E-07	20.05	3.97E-06	84.97	2.15E-04
8.03	2.28E-07	21.00	4.52E-06	88.89	2.67E-04
7.89	2.24E-07	21.96	5.19E-06	92.85	3.39E-04
7.75	2.07E-07	22.97	5.83E-06	97.05	4.47E-04
7.62	1.91E-07	24.04	6.49E-06	101.45	5.10E-04
7.48	1.77E-07	25.15	7.21E-06	105.76	7.10E-04

Table B35. Constant-R (increasing ΔK) FCG data for specimen 4 – S-T of D6AC Steel.

Specimen ID:	4			Orientation:	S-T
Test:	R = 0.1				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
10.15	3.36E-07	21.33	3.76E-06	44.78	1.97E-05
10.34	3.57E-07	21.73	3.96E-06	45.61	2.04E-05
10.53	3.81E-07	22.12	4.14E-06	46.45	2.13E-05
10.72	4.08E-07	22.51	4.30E-06	47.30	2.22E-05
10.91	4.32E-07	22.92	4.51E-06	48.18	2.32E-05
11.11	4.59E-07	23.33	4.74E-06	49.05	2.43E-05
11.32	4.90E-07	23.76	4.97E-06	49.95	2.54E-05
11.52	5.22E-07	24.20	5.20E-06	50.85	2.63E-05
11.74	5.53E-07	24.64	5.43E-06	51.79	2.74E-05
11.95	5.81E-07	25.10	5.66E-06	52.72	2.89E-05
12.17	6.09E-07	25.57	5.93E-06	53.68	3.03E-05
12.39	6.45E-07	26.03	6.19E-06	54.63	3.16E-05
12.62	6.82E-07	26.50	6.48E-06	55.65	3.32E-05
12.85	7.16E-07	26.99	6.77E-06	56.66	3.49E-05
13.09	7.60E-07	27.48	7.01E-06	57.71	3.66E-05
13.33	8.03E-07	27.99	7.27E-06	58.77	3.85E-05
13.57	8.50E-07	28.50	7.56E-06	59.82	4.01E-05
13.82	9.04E-07	29.01	7.83E-06	60.92	4.23E-05
14.07	9.51E-07	29.53	8.13E-06	62.02	4.48E-05
14.32	1.01E-06	30.07	8.48E-06	63.18	4.70E-05
14.58	1.07E-06	30.63	8.85E-06	64.35	4.91E-05
14.85	1.14E-06	31.19	9.19E-06	65.54	5.14E-05
15.12	1.21E-06	31.75	9.53E-06	66.74	5.41E-05
15.40	1.27E-06	32.33	9.90E-06	67.94	5.71E-05
15.68	1.35E-06	32.92	1.03E-05	69.17	6.04E-05
15.97	1.45E-06	33.52	1.06E-05	70.43	6.40E-05
16.26	1.55E-06	34.14	1.11E-05	71.70	6.78E-05
16.55	1.65E-06	34.77	1.15E-05	73.00	7.15E-05
16.86	1.76E-06	35.40	1.19E-05	74.35	7.51E-05
17.16	1.87E-06	36.04	1.24E-05	75.68	7.90E-05
17.48	1.99E-06	36.70	1.28E-05	77.06	8.46E-05
17.80	2.12E-06	37.37	1.33E-05	78.44	9.12E-05
18.11	2.25E-06	38.07	1.38E-05	79.85	9.70E-05
18.44	2.39E-06	38.77	1.44E-05	81.32	1.03E-04
18.78	2.56E-06	39.47	1.49E-05	82.81	1.08E-04
19.13	2.71E-06	40.20	1.55E-05	84.30	1.14E-04
19.48	2.85E-06	40.92	1.62E-05	85.87	1.21E-04
19.84	3.03E-06	41.68	1.68E-05	87.39	1.29E-04
20.20	3.22E-06	42.43	1.75E-05	88.98	1.36E-04
20.57	3.38E-06	43.21	1.81E-05		
20.95	3.57E-06	44.00	1.89E-05		

Table B36. Constant-K_{max} FCG data for specimen 4 – S-T of D6AC Steel.

Specimen ID:	4			Orientation:	S-T
Test:	K_{max} = 15 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
9.26	3.71E-07	3.95	4.71E-08	2.75	9.03E-09
8.85	3.36E-07	3.79	4.11E-08	2.72	7.78E-09
8.46	3.02E-07	3.65	3.54E-08	2.70	7.15E-09
8.09	2.70E-07	3.53	3.14E-08	2.69	6.82E-09
7.73	2.40E-07	3.42	2.75E-08	2.67	6.56E-09
7.40	2.15E-07	3.34	2.41E-08	2.65	6.10E-09
7.07	1.94E-07	3.26	2.25E-08	2.63	5.84E-09
6.76	1.75E-07	3.19	2.03E-08	2.62	5.22E-09
6.46	1.58E-07	3.13	1.85E-08	2.61	4.42E-09
6.18	1.41E-07	3.08	1.71E-08	2.60	4.27E-09
5.91	1.25E-07	3.02	1.62E-08	2.59	3.09E-09
5.65	1.12E-07	2.98	1.47E-08	2.58	3.25E-09
5.40	1.00E-07	2.94	1.32E-08	2.57	3.96E-09
5.17	9.09E-08	2.90	1.24E-08	2.56	4.02E-09
4.94	8.32E-08	2.87	1.01E-08	2.55	4.43E-09
4.72	7.48E-08	2.84	9.10E-09	2.54	4.84E-09
4.51	6.57E-08	2.82	8.79E-09	2.53	2.65E-09
4.31	5.78E-08	2.79	7.91E-09		
4.13	5.23E-08	2.77	8.23E-09		

Table B37. Constant-K_{max} FCG data for specimen 5 – S-T of D6AC Steel.

Specimen ID:	5			Orientation:	S-T
Test:	K_{max} = 20 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
17.12	1.60E-06	9.13	3.87E-07	4.97	8.55E-08
16.62	1.48E-06	8.86	3.58E-07	4.69	7.73E-08
16.13	1.46E-06	8.60	3.32E-07	4.55	7.27E-08
15.65	1.42E-06	8.34	3.11E-07	4.41	6.65E-08
15.19	1.33E-06	8.10	2.87E-07	4.28	5.93E-08
14.75	1.24E-06	7.86	2.63E-07	4.16	5.43E-08
14.31	1.16E-06	7.63	2.45E-07	4.03	5.67E-08
13.89	1.09E-06	7.41	2.27E-07	3.91	4.95E-08
13.47	1.01E-06	7.19	2.13E-07	3.79	3.83E-08
13.08	9.49E-07	6.97	1.97E-07	3.69	3.60E-08
12.70	8.84E-07	6.77	1.81E-07	3.58	3.36E-08
12.33	8.19E-07	6.56	1.71E-07	3.47	3.08E-08
11.96	7.61E-07	6.37	1.60E-07	3.37	2.86E-08
11.61	7.05E-07	6.18	1.48E-07	3.27	2.54E-08
11.26	6.53E-07	6.00	1.38E-07	3.17	2.18E-08
10.93	6.06E-07	5.82	1.29E-07	3.08	2.00E-08
10.60	5.60E-07	5.65	1.19E-07	2.99	1.80E-08
10.29	5.22E-07	5.48	1.11E-07	2.90	1.63E-08
9.99	4.83E-07	5.41	9.26E-08	2.82	1.30E-08
9.69	4.44E-07	5.28	1.36E-07		
9.41	4.14E-07	5.09	1.14E-07		

Table B38. Constant-R (decreasing then increasing ΔK) FCG data for specimen 7 – S-T of D6AC Steel.

Specimen ID:	7			Orientation:	S-T
Test:	R = 0.7				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
8.27	2.95E-07	4.81	7.88E-08	2.69	2.88E-09
8.26	3.24E-07	4.72	7.63E-08	9.23	4.83E-07
8.19	3.43E-07	4.64	7.34E-08	10.17	5.93E-07
8.10	3.00E-07	4.56	7.05E-08	10.65	6.61E-07
7.96	2.68E-07	4.47	7.03E-08	11.13	7.44E-07
7.82	2.51E-07	4.39	6.84E-08	11.64	8.42E-07
7.68	2.41E-07	4.31	6.35E-08	12.17	9.67E-07
7.55	2.33E-07	4.24	5.94E-08	12.73	1.13E-06
7.41	2.20E-07	4.16	5.52E-08	13.32	1.30E-06
7.28	2.07E-07	4.09	5.14E-08	13.94	1.51E-06
7.15	1.98E-07	4.01	4.85E-08	14.58	1.75E-06
7.02	1.88E-07	3.94	4.57E-08	15.26	2.03E-06
6.90	1.77E-07	3.87	4.29E-08	15.96	2.34E-06
6.77	1.70E-07	3.80	4.02E-08	16.70	2.64E-06
6.65	1.64E-07	3.73	3.79E-08	18.23	3.01E-06
6.53	1.58E-07	3.66	3.66E-08	19.92	4.17E-06
6.42	1.52E-07	3.60	3.47E-08	20.83	4.65E-06
6.30	1.49E-07	3.53	3.21E-08	21.81	5.16E-06
6.19	1.43E-07	3.47	2.97E-08	22.79	5.73E-06
6.08	1.36E-07	3.41	2.73E-08	23.84	6.34E-06
5.97	1.31E-07	3.35	2.51E-08	24.93	7.04E-06
5.87	1.26E-07	3.28	2.34E-08	26.07	7.78E-06
5.76	1.22E-07	3.23	2.17E-08	27.28	8.58E-06
5.66	1.18E-07	3.17	2.00E-08	28.53	9.33E-06
5.56	1.13E-07	3.11	1.84E-08	29.85	1.04E-05
5.46	1.09E-07	3.05	1.64E-08	31.20	1.15E-05
5.36	1.04E-07	3.00	1.43E-08	32.64	1.23E-05
5.26	9.80E-08	2.95	1.22E-08	34.12	1.41E-05
5.17	9.39E-08	2.89	1.09E-08	35.71	1.65E-05
5.08	9.10E-08	2.84	9.59E-09	37.28	1.86E-05
4.98	8.60E-08	2.79	8.32E-09	45.01	5.68E-05
4.90	8.15E-08	2.74	7.72E-09	46.68	7.52E-05

Table B39. Constant-R (decreasing then increasing ΔK) FCG data for specimen 8 – S-T of D6AC Steel.

Specimen ID:	8			Orientation:	S-T
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
8.54	3.24E-07	3.56	2.83E-08	18.38	3.25E-06
8.39	3.12E-07	3.50	2.61E-08	18.72	3.41E-06
8.24	2.99E-07	3.44	2.42E-08	19.06	3.58E-06
8.09	2.84E-07	3.37	2.21E-08	19.42	3.79E-06
7.95	2.70E-07	3.31	2.02E-08	19.77	4.00E-06
7.80	2.61E-07	3.25	1.86E-08	20.13	4.14E-06
7.67	2.50E-07	3.20	1.65E-08	20.49	4.28E-06
7.53	2.38E-07	3.14	1.47E-08	20.86	4.47E-06
7.39	2.27E-07	3.08	1.34E-08	21.24	4.68E-06
7.26	2.17E-07	3.03	1.16E-08	21.62	4.85E-06
7.13	2.07E-07	2.97	1.01E-08	22.01	4.94E-06
7.01	1.98E-07	2.92	9.48E-09	22.40	5.10E-06
6.88	1.89E-07	2.87	8.52E-09	22.81	5.37E-06
6.76	1.80E-07	2.82	7.45E-09	23.23	5.57E-06
6.64	1.72E-07	9.62	4.51E-07	23.66	5.78E-06
6.52	1.64E-07	9.80	4.80E-07	24.09	6.06E-06
6.41	1.57E-07	9.98	5.05E-07	24.53	6.30E-06
6.30	1.52E-07	10.16	5.28E-07	24.97	6.59E-06
6.18	1.43E-07	10.34	5.57E-07	25.42	6.88E-06
6.07	1.36E-07	10.53	5.88E-07	25.88	7.13E-06
5.97	1.31E-07	10.72	6.16E-07	26.36	7.40E-06
5.86	1.27E-07	10.92	6.47E-07	26.84	7.62E-06
5.76	1.22E-07	11.12	6.80E-07	27.34	7.96E-06
5.65	1.18E-07	11.32	7.15E-07	27.83	8.33E-06
5.62	1.18E-07	11.52	7.51E-07	28.34	8.62E-06
5.59	1.14E-07	11.73	7.97E-07	28.84	9.12E-06
5.49	1.10E-07	11.94	8.45E-07	29.37	9.57E-06
5.39	1.05E-07	12.16	8.99E-07	29.89	9.76E-06
5.29	9.88E-08	12.38	9.56E-07	30.43	1.03E-05
5.20	9.58E-08	12.60	9.95E-07	30.98	1.08E-05
5.11	9.18E-08	12.84	1.05E-06	31.54	1.11E-05
5.02	8.64E-08	13.07	1.12E-06	32.13	1.15E-05
4.93	8.28E-08	13.31	1.19E-06	32.71	1.17E-05
4.84	7.95E-08	13.55	1.26E-06	33.30	1.20E-05
4.75	7.59E-08	13.79	1.33E-06	33.91	1.27E-05
4.67	7.22E-08	14.04	1.41E-06	34.52	1.33E-05
4.58	6.80E-08	14.29	1.49E-06	35.15	1.38E-05
4.50	6.43E-08	14.55	1.57E-06	35.79	1.41E-05
4.42	6.05E-08	14.82	1.67E-06	36.45	1.45E-05
4.34	5.74E-08	15.08	1.78E-06	37.11	1.57E-05
4.26	5.47E-08	15.36	1.89E-06	*37.78*	*1.72E-05*
4.19	5.13E-08	15.64	2.02E-06	*38.46*	*1.84E-05*
4.11	4.80E-08	15.93	2.12E-06	*39.16*	*1.95E-05*
4.04	4.54E-08	16.22	2.25E-06	*39.87*	*2.08E-05*

3.97	4.28E-08	16.51	2.42E-06	*40.64*	*2.33E-05*
3.90	3.98E-08	16.81	2.55E-06	*41.36*	*2.73E-05*
3.83	3.73E-08	17.12	2.67E-06	*42.12*	*2.84E-05*
3.76	3.52E-08	17.43	2.81E-06	*42.88*	*2.86E-05*
3.69	3.32E-08	17.74	2.97E-06		
3.63	3.06E-08	18.06	3.12E-06		

Table B40. Constant-R (decreasing then increasing ΔK) FCG data for specimen 9 – S-T of D6AC Steel.

Specimen ID:	9			Orientation:	S-T
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
4.41	6.35E-08	8.26	3.15E-07	15.97	2.12E-06
4.34	6.02E-08	8.42	3.29E-07	16.26	2.25E-06
4.26	5.75E-08	8.57	3.43E-07	16.55	2.40E-06
4.19	5.40E-08	8.73	3.57E-07	16.86	2.54E-06
4.11	5.09E-08	8.90	3.76E-07	17.17	2.66E-06
4.04	4.91E-08	9.06	3.97E-07	17.49	2.78E-06
3.97	4.56E-08	9.23	4.18E-07	17.81	2.93E-06
3.90	4.27E-08	9.39	4.40E-07	18.14	3.07E-06
3.83	4.11E-08	9.56	4.63E-07	18.47	3.14E-06
3.76	3.77E-08	9.74	4.86E-07	18.82	3.34E-06
3.69	3.47E-08	9.92	5.11E-07	19.16	3.57E-06
3.62	3.27E-08	10.10	5.36E-07	19.52	3.73E-06
3.56	3.04E-08	10.29	5.64E-07	19.88	3.88E-06
3.50	2.74E-08	10.49	5.91E-07	20.24	4.04E-06
3.44	2.49E-08	10.68	6.18E-07	20.61	4.23E-06
3.38	2.30E-08	10.88	6.53E-07	20.99	4.42E-06
3.32	2.09E-08	11.07	6.88E-07	21.37	4.58E-06
3.26	1.86E-08	11.28	7.18E-07	21.78	4.81E-06
3.20	1.67E-08	11.49	7.63E-07	22.18	5.06E-06
3.14	1.50E-08	12.36	9.65E-07	22.59	5.32E-06
3.09	1.37E-08	12.59	1.02E-06	22.99	5.34E-06
3.04	1.24E-08	12.82	1.08E-06	23.42	5.51E-06
2.98	1.05E-08	13.05	1.14E-06	23.84	5.97E-06
2.93	9.37E-09	13.29	1.21E-06	24.29	6.09E-06
2.88	9.92E-09	13.53	1.28E-06	24.73	6.19E-06
2.83	9.69E-09	13.79	1.34E-06	25.19	6.43E-06
7.27	2.32E-07	14.05	1.44E-06	25.66	6.67E-06
7.40	2.41E-07	14.31	1.52E-06	26.13	6.99E-06
7.54	2.51E-07	14.57	1.59E-06	26.60	7.19E-06
7.68	2.62E-07	14.84	1.68E-06	27.10	7.60E-06
7.82	2.76E-07	15.11	1.79E-06	27.59	8.08E-06
7.97	2.90E-07	15.39	1.92E-06	28.12	8.36E-06
8.12	3.03E-07	15.68	2.04E-06		

Table B41. Constant-R (increasing ΔK) FCG data for specimen 12 – S-T of D6AC Steel.

Specimen ID:	12			Orientation:	S-T
Test:	R = 0.1				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
18.05	1.91E-06	34.94	1.14E-05	68.33	6.01E-05
18.35	1.98E-06	35.90	1.21E-05	70.22	6.50E-05
18.82	2.09E-06	36.88	1.27E-05	72.14	7.08E-05
19.34	2.25E-06	37.91	1.35E-05	74.10	7.76E-05
19.87	2.47E-06	38.91	1.43E-05	76.14	8.48E-05
20.42	2.72E-06	40.00	1.53E-05	78.19	9.31E-05
20.99	2.98E-06	41.02	1.63E-05	80.34	1.03E-04
21.56	3.25E-06	42.16	1.73E-05	82.54	1.15E-04
22.14	3.54E-06	43.31	1.85E-05	84.73	1.27E-04
22.73	3.84E-06	44.48	1.97E-05	87.00	1.39E-04
23.33	4.18E-06	45.72	2.11E-05	89.31	1.51E-04
23.96	4.53E-06	46.95	2.24E-05	91.70	1.65E-04
24.62	4.88E-06	48.22	2.37E-05	94.24	1.79E-04
25.29	5.25E-06	49.56	2.52E-05	96.76	1.95E-04
26.00	5.66E-06	50.90	2.66E-05	99.37	2.10E-04
26.71	6.06E-06	52.30	2.83E-05	102.11	2.27E-04
27.45	6.54E-06	53.70	3.04E-05	104.83	2.50E-04
28.18	6.94E-06	55.15	3.30E-05	107.69	2.74E-04
28.99	7.41E-06	56.63	3.59E-05	110.56	3.01E-04
29.74	7.87E-06	58.16	3.83E-05	113.49	3.33E-04
30.58	8.34E-06	59.75	4.08E-05	116.51	3.73E-04
31.39	8.97E-06	61.37	4.37E-05	119.65	4.05E-04
32.24	9.62E-06	63.07	4.72E-05	122.82	4.66E-04
33.12	1.02E-05	64.78	5.13E-05		
34.01	1.08E-05	66.54	5.56E-05		

Table B42. Constant-R (decreasing then increasing ΔK) FCG data for specimen 13 – S-T of D6AC Steel.

Specimen ID:	13			Orientation:	S-T
Test:	R = 0.3				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
13.85	9.62E-07	8.08	1.96E-07	14.43	1.03E-06
13.80	9.41E-07	7.93	1.77E-07	22.07	4.56E-06
13.67	9.03E-07	7.79	1.66E-07	23.08	5.04E-06
13.49	8.99E-07	7.65	1.49E-07	24.16	5.65E-06
13.24	8.87E-07	7.51	1.30E-07	25.24	6.24E-06
12.99	7.99E-07	7.37	1.17E-07	26.40	6.49E-06
12.75	7.18E-07	7.24	1.09E-07	27.61	7.36E-06
12.53	7.30E-07	7.11	1.02E-07	28.83	8.17E-06
12.30	7.25E-07	6.98	9.50E-08	30.17	8.74E-06
12.08	6.52E-07	6.85	8.50E-08	31.51	9.84E-06
11.85	6.26E-07	6.73	7.50E-08	35.86	1.31E-05
11.64	6.52E-07	6.61	6.53E-08	37.72	1.47E-05
11.44	6.16E-07	6.49	5.78E-08	39.36	1.61E-05
11.23	5.52E-07	6.37	5.17E-08	41.17	1.78E-05
11.03	5.33E-07	6.26	4.59E-08	43.05	1.97E-05
10.83	5.24E-07	6.14	4.17E-08	45.03	2.20E-05
10.63	4.79E-07	6.03	3.84E-08	47.06	2.47E-05
10.43	4.86E-07	5.92	3.65E-08	49.19	2.78E-05
10.24	4.87E-07	5.81	3.21E-08	51.41	3.13E-05
10.06	4.28E-07	5.70	2.70E-08	53.80	3.55E-05
9.88	3.96E-07	5.61	2.43E-08	56.26	4.00E-05
9.70	4.10E-07	5.51	2.23E-08	58.84	4.58E-05
9.54	3.85E-07	5.41	2.02E-08	61.50	5.41E-05
9.36	3.49E-07	5.31	1.70E-08	64.34	6.42E-05
9.20	3.49E-07	5.21	1.38E-08	67.26	7.41E-05
9.03	3.24E-07	5.12	1.06E-08	70.32	8.59E-05
8.86	2.99E-07	13.61	1.11E-06	73.48	1.03E-04
8.70	2.79E-07	13.61	1.06E-06	76.78	1.27E-04
8.54	2.52E-07	13.61	1.08E-06	80.21	1.57E-04
8.38	2.39E-07	13.60	1.06E-06	83.79	1.83E-04
8.23	2.26E-07	13.60	1.05E-06	87.63	2.25E-04

Table B43. Constant-R (increasing ΔK) FCG data for specimen 14 – S-T of D6AC Steel.

Specimen ID:	14			Orientation:	S-T
Test:	R = 0.8				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
6.00	1.51E-07	9.08	4.46E-07	13.96	1.56E-06
6.05	1.54E-07	9.24	4.69E-07	14.22	1.65E-06
6.12	1.58E-07	9.41	4.93E-07	14.48	1.75E-06
6.22	1.64E-07	9.58	5.17E-07	14.74	1.84E-06
6.34	1.72E-07	9.76	5.42E-07	15.01	1.94E-06
6.45	1.82E-07	9.93	5.68E-07	15.28	2.04E-06
6.57	1.92E-07	10.11	5.97E-07	15.55	2.16E-06
6.69	2.02E-07	10.29	6.27E-07	15.83	2.29E-06
6.81	2.11E-07	10.48	6.59E-07	16.11	2.43E-06
6.94	2.20E-07	10.67	6.92E-07	16.40	2.58E-06
7.06	2.28E-07	10.86	7.27E-07	16.70	2.73E-06
7.19	2.38E-07	11.06	7.66E-07	17.00	2.88E-06
7.32	2.49E-07	11.26	8.07E-07	17.31	3.03E-06
7.46	2.61E-07	11.46	8.52E-07	17.63	3.17E-06
7.59	2.74E-07	11.67	9.03E-07	17.95	3.32E-06
7.73	2.88E-07	11.88	9.57E-07	18.27	3.36E-06
7.86	3.02E-07	12.09	1.01E-06	18.60	3.47E-06
8.00	3.17E-07	12.31	1.07E-06	18.91	3.60E-06
8.15	3.32E-07	12.53	1.13E-06	19.28	3.79E-06
8.30	3.48E-07	12.76	1.19E-06	19.61	4.08E-06
8.45	3.65E-07	12.99	1.25E-06	19.99	4.42E-06
8.60	3.83E-07	13.23	1.32E-06	20.35	4.76E-06
8.76	4.03E-07	13.47	1.39E-06		
8.91	4.25E-07	13.71	1.48E-06		

Table B44. Constant-R (increasing ΔK) FCG data for specimen 15 – S-T of D6AC Steel.

Specimen ID:	15			Orientation:	S-T
Test:	R = 0.8				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
10.01	5.59E-07	12.73	1.19E-06	17.12	3.05E-06
10.01	5.53E-07	13.08	1.31E-06	17.58	3.32E-06
10.12	5.65E-07	13.44	1.43E-06	18.06	3.63E-06
10.27	6.03E-07	13.80	1.55E-06	18.56	3.99E-06
10.53	6.61E-07	14.17	1.70E-06	19.07	4.34E-06
10.82	7.33E-07	14.56	1.84E-06	19.60	4.68E-06
11.12	8.01E-07	14.96	2.00E-06	20.14	4.98E-06
11.43	8.68E-07	15.37	2.18E-06	20.68	5.31E-06
11.74	9.39E-07	15.79	2.38E-06	21.25	5.59E-06
12.06	1.01E-06	16.23	2.59E-06	21.84	5.99E-06
12.39	1.10E-06	16.67	2.81E-06		

Table B45. Constant-R (increasing ΔK) FCG data for specimen 16 – S-T of D6AC Steel.

Specimen ID:	16			Orientation:	S-T
Test:	R = 0.9				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
8.00	3.81E-07	9.98	6.96E-07	12.74	1.68E-06
8.11	3.90E-07	10.26	7.56E-07	13.08	1.89E-06
8.26	4.09E-07	10.54	8.26E-07	13.43	2.14E-06
8.49	4.35E-07	10.83	9.03E-07	13.80	2.44E-06
8.73	4.69E-07	11.13	9.83E-07	14.18	2.91E-06
8.97	5.07E-07	11.43	1.07E-06	14.57	3.11E-06
9.22	5.50E-07	11.74	1.19E-06	14.91	4.01E-06
9.46	5.95E-07	12.07	1.32E-06		
9.72	6.44E-07	12.40	1.48E-06		

Table B46. Constant-R (decreasing ΔK) FCG data for specimen 17 – S-T of D6AC Steel.

Specimen ID:	17			Orientation:	S-T
Test:	R = 0.1				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
11.81	5.19E-07	9.57	1.90E-07	7.55	4.64E-08
11.74	6.01E-07	9.40	1.70E-07	7.42	4.41E-08
11.65	5.96E-07	9.23	1.56E-07	7.29	3.75E-08
11.49	5.03E-07	9.08	1.36E-07	7.15	3.30E-08
11.29	4.57E-07	8.91	1.28E-07	7.03	2.99E-08
11.10	4.27E-07	8.75	1.22E-07	6.90	1.77E-08
10.89	3.73E-07	8.58	1.06E-07	6.79	1.17E-08
10.68	3.34E-07	8.42	1.03E-07	6.68	9.30E-09
10.50	3.06E-07	8.26	1.01E-07	6.56	8.26E-09
10.31	2.70E-07	8.12	9.13E-08	6.47	7.10E-09
10.14	2.42E-07	7.97	8.39E-08	6.40	5.43E-09
9.93	2.26E-07	7.83	7.48E-08	5.95	1.31E-09
9.75	2.14E-07	7.70	5.75E-08		

Table B47. Constant-R (increasing ΔK) FCG data for specimen 19 – S-T of D6AC Steel.

Specimen ID:	19			Orientation:	S-T
Test:	R = 0.3				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
7.63	2.07E-07	24.61	6.46E-06	45.68	2.54E-05
7.71	2.15E-07	25.05	6.71E-06	46.50	2.66E-05
7.88	2.31E-07	25.50	7.01E-06	47.32	2.77E-05
8.16	2.59E-07	25.95	7.31E-06	48.18	2.89E-05
8.53	2.95E-07	26.42	7.60E-06	49.04	3.02E-05
8.92	3.39E-07	26.90	7.91E-06	49.94	3.16E-05
9.33	3.84E-07	27.38	8.26E-06	50.81	3.86E-05
9.76	4.33E-07	27.87	8.59E-06	51.72	4.02E-05
10.21	4.88E-07	28.36	8.91E-06	54.12	4.25E-05
10.68	5.52E-07	28.85	9.28E-06	55.45	5.00E-05
11.16	6.24E-07	29.36	9.67E-06	58.59	5.44E-05
11.67	6.99E-07	29.89	1.00E-05	60.08	5.71E-05
12.20	7.85E-07	30.43	1.04E-05	61.72	6.34E-05
12.76	8.81E-07	30.97	1.07E-05	62.81	6.63E-05
13.35	1.00E-06	31.53	1.11E-05	63.96	6.98E-05
13.96	1.15E-06	32.09	1.15E-05	65.10	7.38E-05
14.60	1.31E-06	32.66	1.20E-05	66.27	7.87E-05
15.26	1.51E-06	33.24	1.25E-05	67.45	8.35E-05
15.96	1.76E-06	33.84	1.29E-05	68.64	8.85E-05
16.68	2.06E-06	34.44	1.34E-05	69.83	9.45E-05
17.45	2.42E-06	35.06	1.39E-05	71.07	1.02E-04
18.25	2.82E-06	35.69	1.44E-05	72.32	1.09E-04
19.32	3.20E-06	36.32	1.50E-05	73.65	1.17E-04
19.88	3.47E-06	36.95	1.56E-05	74.93	1.26E-04
20.55	3.68E-06	37.62	1.62E-05	76.28	1.35E-04
20.70	4.16E-06	38.28	1.68E-05	77.63	1.47E-04
20.99	4.33E-06	38.96	1.74E-05	79.00	1.61E-04
21.38	4.53E-06	39.66	1.82E-05	80.42	1.79E-04
21.76	4.74E-06	40.36	1.89E-05	81.85	1.98E-04
22.15	4.98E-06	41.09	1.97E-05	83.29	2.19E-04
22.54	5.23E-06	41.82	2.05E-05	*84.76*	*2.40E-04*
22.94	5.47E-06	42.58	2.14E-05	*86.24*	*2.61E-04*
23.35	5.71E-06	43.33	2.23E-05	*87.74*	*2.82E-04*
23.76	5.95E-06	44.12	2.32E-05	*89.29*	*3.05E-04*
24.18	6.20E-06	44.89	2.43E-05		

Table B48. Constant-K_{max} FCG data for specimen 19 – S-T of D6AC Steel.

Specimen ID:	19			Orientation:	S-T
Test:	K_{max} = 30 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
20.64	3.86E-06	8.96	4.78E-07	3.32	4.04E-08
20.34	3.77E-06	8.22	3.73E-07	3.05	2.59E-08
19.53	3.67E-06	7.49	3.05E-07	2.83	1.66E-08
18.42	3.53E-06	6.87	2.49E-07	2.66	1.12E-08
16.87	3.26E-06	6.27	2.00E-07	2.54	8.00E-09
15.44	2.56E-06	5.70	1.60E-07	2.46	5.92E-09
14.05	1.82E-06	5.23	1.29E-07	2.40	4.50E-09
12.89	1.34E-06	4.76	1.06E-07	2.36	3.58E-09
11.75	1.03E-06	4.34	8.90E-08	2.32	2.97E-09
10.73	7.90E-07	3.97	7.36E-08	2.28	2.52E-09
9.83	6.17E-07	3.63	5.80E-08	2.26	2.21E-09

APPENDIX C

The fatigue crack growth rate data (a, N, da/dN and ΔK) of D6AC steel alloy are listed in Tables C1 through C3 of this appendix sequentially by specimen orientation and number.

Table C1. Crack growth data for specimen 28 - L-T of D6AC Steel.

Specimen ID:	28		Orientation:	L-T
Test:	Constant ΔK = 10.8 ksi $in^{1/2}$			
	Constant R = 0.1 Load Reduction			
	Constant ΔK = 7.0 ksi $in^{1/2}$			
	Constant ΔK = 7.6 ksi $in^{1/2}$			
	Constant ΔK = 8.7 ksi $in^{1/2}$			
	Constant ΔK = 9.7 ksi $in^{1/2}$			

a (inch)	N (cycles)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	Test condition
0.711	98,454	0.00	0.00E+00	precrack
0.724	213,024	10.71	1.55E-07	
0.734	245,747	10.71	3.11E-07	
0.743	273,703	10.72	3.28E-07	
0.752	299,483	10.72	3.55E-07	
0.761	324,600	10.72	3.76E-07	
0.771	348,149	10.72	3.92E-07	
0.779	369,825	10.72	4.08E-07	
0.789	391,890	10.73	4.25E-07	
0.798	414,915	10.73	4.47E-07	
0.808	436,166	10.74	4.71E-07	
0.818	455,442	10.74	4.94E-07	
0.827	474,193	10.75	5.19E-07	
0.837	492,573	10.76	5.36E-07	
0.847	510,379	10.77	4.99E-07	
0.857	527,616	10.77	4.66E-07	
0.866	544,852	10.20	2.97E-07	
0.861	596,593	10.79	2.90E-07	
0.886	648,665	10.21	4.80E-07	
0.895	665,716	10.80	5.40E-07	Constant ΔK = 10.8 ksi $in^{1/2}$
0.905	682,412	10.80	5.37E-07	
0.914	699,648	10.81	5.54E-07	
0.924	716,884	10.81	5.50E-07	
0.933	734,121	10.82	5.44E-07	
0.943	752,075	10.82	5.40E-07	
0.952	770,030	10.83	5.37E-07	
0.961	787,266	10.83	5.34E-07	
0.971	805,221	10.84	5.33E-07	
0.981	823,893	10.84	5.32E-07	
0.990	841,848	10.85	5.30E-07	
1.000	859,803	10.86	5.30E-07	
1.009	877,757	10.86	5.29E-07	

1.019	895,712	10.87	5.28E-07	
1.029	914,384	10.87	5.26E-07	
1.038	932,339	10.88	5.24E-07	
1.048	950,293	10.88	5.24E-07	
1.057	968,248	10.88	5.25E-07	
1.066	986,203	10.89	5.22E-07	
1.076	1,004,875	10.89	5.20E-07	Constant R = 0.1 Load Reduction
1.086	1,023,712	10.84	5.12E-07	
1.094	1,039,611	10.75	5.01E-07	
1.104	1,059,332	10.60	4.83E-07	
1.113	1,080,342	10.41	4.60E-07	
1.123	1,102,756	10.23	4.22E-07	
1.133	1,127,234	10.05	3.91E-07	
1.142	1,153,940	9.88	3.61E-07	
1.152	1,182,415	9.71	3.35E-07	
1.161	1,212,673	9.54	3.13E-07	
1.170	1,245,127	9.37	2.93E-07	
1.180	1,279,786	9.21	2.75E-07	
1.189	1,316,746	9.04	2.56E-07	
1.199	1,357,010	8.89	2.38E-07	
1.209	1,401,006	8.73	2.20E-07	
1.218	1,447,700	8.58	2.03E-07	
1.227	1,498,589	8.43	1.86E-07	
1.237	1,555,745	8.28	1.70E-07	
1.247	1,618,218	8.14	1.53E-07	
1.256	1,689,787	8.00	1.36E-07	
1.265	1,769,706	7.86	1.23E-07	
1.275	1,855,930	7.72	1.10E-07	
1.284	1,951,875	7.59	1.01E-07	
1.294	2,062,498	7.46	8.92E-08	
1.303	2,194,620	7.32	7.52E-08	
1.313	2,364,898	7.20	6.17E-08	
1.322	2,559,258	7.07	5.22E-08	
1.332	2,766,332	6.99	4.69E-08	
1.341	2,983,507	6.93	4.47E-08	
1.350	3,200,678	6.91	4.49E-08	
1.359	3,407,749	6.92	4.39E-08	
1.369	3,604,719	6.92	4.34E-08	
1.379	3,801,689	6.92	4.23E-08	
1.387	4,059,264	6.92	4.11E-08	
1.397	4,331,991	6.93	4.12E-08	
1.407	4,549,166	6.93	4.21E-08	
1.416	4,751,187	6.93	4.45E-08	
1.425	4,958,258	6.94	4.67E-08	
1.435	5,175,432	6.94	4.62E-08	
1.444	5,352,199	6.94	4.59E-08	
1.454	5,528,967	6.94	4.58E-08	Constant $\Delta K = 7.0$ ksi in$^{1/2}$
1.462	5,766,341	6.95	4.57E-08	
1.472	5,993,614	6.95	4.62E-08	
1.482	6,185,533	6.95	4.70E-08	

1.491	6,367,353	6.96	4.96E-08	
1.500	6,554,224	6.96	5.04E-08	
1.510	6,751,194	6.96	5.11E-08	
1.520	6,938,062	6.96	5.07E-08	
1.529	7,104,729	6.97	5.04E-08	
1.537	7,271,395	6.97	5.06E-08	
1.546	7,473,416	6.97	5.02E-08	
1.556	7,675,436	6.98	5.11E-08	
1.566	7,852,204	6.98	5.21E-08	
1.575	8,023,921	6.98	5.36E-08	
1.585	8,195,641	6.98	5.77E-08	
1.594	8,367,358	6.99	6.55E-08	
1.603	8,533,729	7.28	7.97E-08	Transition
1.614	8,638,694	7.29	8.93E-08	
1.621	8,712,943	7.59	9.40E-08	
1.631	8,805,751	7.61	1.02E-07	Constant $\Delta K = 7.6$ ksi in$^{1/2}$
1.640	8,897,499	7.61	1.04E-07	
1.650	8,989,246	7.62	1.03E-07	
1.659	9,080,993	7.62	1.02E-07	
1.668	9,169,781	7.62	1.03E-07	
1.678	9,262,268	7.63	1.04E-07	
1.687	9,351,056	7.63	1.06E-07	
1.696	9,436,145	7.63	1.17E-07	
1.705	9,521,233	7.77	1.39E-07	
1.714	9,596,584	8.14	1.70E-07	Transition
1.723	9,634,114	8.29	1.84E-07	
1.733	9,679,383	8.66	1.99E-07	Constant $\Delta K = 8.7$ ksi in$^{1/2}$
1.742	9,723,322	8.67	2.15E-07	
1.751	9,767,261	8.67	2.11E-07	
1.761	9,811,201	8.68	2.11E-07	
1.770	9,853,625	8.68	2.11E-07	
1.779	9,897,565	8.68	2.11E-07	
1.788	9,941,504	8.69	2.14E-07	
1.797	9,983,928	8.69	2.24E-07	
1.806	10,026,352	8.87	2.46E-07	Transition
1.816	10,069,187	9.21	2.78E-07	
1.826	10,097,447	9.39	2.98E-07	
1.835	10,124,341	9.74	3.13E-07	Constant $\Delta K = 9.7$ ksi in$^{1/2}$
1.843	10,151,311	9.74	3.29E-07	
1.853	10,179,190	9.74	3.29E-07	
1.862	10,207,068	9.75	3.28E-07	
1.871	10,234,947	9.75	3.28E-07	
1.880	10,264,038	9.75	3.29E-07	
1.889	10,291,917	9.76	3.35E-07	
1.898	10,318,584	9.76	3.35E-07	
1.907	10,345,250	0.00	0.00E+00	

Table C2. Crack growth data for specimen 31 - L-T of D6AC Steel.

Specimen ID:	31		Orientation:	L-T
Test:	Constant $\Delta K = 7.0$ ksi $in^{1/2}$ Constant R = 0.1 Load Reduction Constant $\Delta K = 7.0$ ksi $in^{1/2}$			

a (inch)	N (cycles)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	Test condition
0.750	114	0.00	0.00E+00	precrack
0.745	253	6.94	-2.49E-05	
0.745	303	6.89	-1.07E-04	
0.734	353	6.95	1.62E-05	
0.746	404	6.91	-4.34E-07	
0.751	456	6.96	-1.57E-08	
0.748	507	7.03	-6.28E-08	
0.746	3,148	7.02	-7.49E-08	
0.749	24,504	7.08	2.98E-07	
0.754	53,232	7.08	1.92E-07	
0.759	77,795	7.08	1.81E-07	
0.764	105,732	7.08	1.79E-07	
0.768	129,423	7.08	1.76E-07	
0.773	159,243	7.08	1.64E-07	
0.779	193,168	7.08	1.48E-07	
0.783	235,987	7.08	1.31E-07	
0.789	284,818	7.08	1.23E-07	
0.794	323,954	7.08	1.18E-07	
0.799	362,176	7.07	1.20E-07	
0.804	409,055	7.07	1.24E-07	
0.809	453,492	7.07	1.27E-07	
0.814	487,321	7.07	1.28E-07	
0.819	520,661	7.07	1.29E-07	
0.824	558,912	7.07	1.31E-07	
0.829	599,729	7.07	1.25E-07	
0.833	641,444	7.07	1.20E-07	
0.839	685,128	7.07	1.22E-07	
0.844	725,641	7.07	1.22E-07	
0.849	764,392	7.07	1.21E-07	
0.854	803,143	7.07	1.18E-07	
0.858	847,182	7.07	1.13E-07	
0.863	894,740	7.07	1.08E-07	
0.868	944,060	7.07	1.07E-07	
0.873	989,857	7.07	1.06E-07	
0.878	1,032,131	7.07	1.03E-07	
0.883	1,081,451	7.06	1.01E-07	
0.888	1,132,532	7.06	9.40E-08	
0.893	1,190,659	7.06	8.49E-08	
0.898	1,261,551	7.06	7.51E-08	
0.903	1,334,757	7.06	6.83E-08	
0.908	1,417,326	7.06	6.53E-08	
0.913	1,498,516	7.06	6.47E-08	
0.918	1,570,758	7.06	6.46E-08	

0.922	1,639,560	7.06	6.50E-08	
0.927	1,714,557	7.06	6.47E-08	
0.932	1,796,435	7.06	6.37E-08	
0.937	1,868,678	7.06	6.24E-08	Constant $\Delta K = 7.0$ ksi in$^{1/2}$
0.941	1,944,362	7.06	6.14E-08	
0.947	2,030,365	7.06	6.00E-08	
0.952	2,119,807	7.06	5.71E-08	
0.957	2,212,690	7.06	5.25E-08	
0.962	2,305,573	7.05	5.09E-08	
0.966	2,398,456	0.00	0.00E+00	
0.973	2,491,291	7.03	6.21E-08	Constant R = 0.1 Load Reduction
0.981	2,637,396	6.96	6.77E-08	
0.991	2,859,985	6.86	6.23E-08	
1.000	3,138,430	6.72	5.10E-08	
1.010	3,539,327	6.59	2.90E-08	
1.020	4,108,350	6.46	1.63E-08	
1.029	4,982,794	6.36	9.12E-09	
1.032	5,533,165	6.31	7.68E-09	
1.034	5,736,502	6.26	7.05E-09	
1.037	6,187,246	6.23	6.54E-09	
1.041	6,687,739	6.20	7.08E-09	
1.043	7,188,515	6.16	6.18E-09	
1.046	7,688,722	6.12	5.78E-09	
1.051	8,188,032	6.09	5.79E-09	
1.052	8,690,572	6.05	5.92E-09	
1.054	9,193,112	6.02	6.57E-09	
1.058	9,690,574	5.98	8.63E-09	
1.061	10,188,036	6.36	1.39E-08	
1.067	10,644,080	6.50	1.26E-08	
1.076	11,026,100	6.90	3.11E-09	
1.081	11,040,381	7.06	3.82E-10	Constant $\Delta K = 7.0$ ksi in$^{1/2}$
1.081	11,055,655	7.06	3.09E-11	
1.082	11,057,639	7.06	-2.04E-08	
1.082	11,059,621	7.06	8.65E-08	
1.082	11,061,605	7.06	1.04E-07	
1.082	11,063,591	7.06	7.81E-08	
1.083	11,065,575	7.06	8.35E-08	
1.083	11,067,559	7.06	7.23E-08	
1.083	11,069,544	7.06	6.28E-08	
1.083	11,071,530	7.06	5.12E-08	
1.083	11,073,514	7.06	2.13E-08	
1.083	11,075,498	7.06	4.09E-09	
1.083	11,077,482	7.06	5.24E-10	
1.083	11,079,466	7.06	3.12E-08	
1.083	11,081,450	7.06	3.47E-08	
1.083	11,083,434	7.06	5.71E-08	
1.084	11,085,417	7.06	8.05E-08	
1.083	11,087,399	7.06	4.62E-08	
1.084	11,089,383	7.06	2.53E-08	
1.084	11,091,367	7.06	-1.01E-09	

1.083	11,093,351	7.06	1.46E-10
1.084	11,095,335	7.06	-7.49E-09
1.083	11,097,319	7.06	-2.62E-08
1.086	11,159,807	7.06	-1.01E-06
1.090	11,285,763	7.06	4.79E-08
1.095	11,432,331	7.06	3.81E-08
1.101	11,586,093	7.06	3.87E-08
1.106	11,698,899	7.06	3.91E-08
1.111	11,809,648	7.06	3.98E-08
1.116	11,951,106	7.06	3.95E-08
1.121	12,089,160	7.06	3.78E-08
1.126	12,216,816	7.06	3.64E-08
1.131	12,349,198	7.06	3.57E-08
1.136	12,495,764	7.06	3.48E-08
1.141	12,647,552	7.06	3.41E-08
1.146	12,789,684	7.06	3.37E-08
1.150	12,941,969	7.06	3.43E-08
1.156	13,089,177	7.06	3.54E-08
1.160	13,216,080	7.06	3.64E-08
1.165	13,353,136	7.06	3.72E-08
1.171	13,485,116	7.06	3.76E-08
1.176	13,617,096	7.06	3.66E-08
1.180	13,754,151	7.06	3.69E-08
1.186	13,886,131	0.00	0.00E+00

Table C3. Crack growth data for specimen 32 - L-T of D6AC Steel.

Specimen ID:	32		Orientation:	L-T
Test:	Constant ΔP, $\Delta K \sim 3.6$ ksi in$^{1/2}$			
	Constant $\Delta K = 7.0$ ksi in$^{1/2}$			
a (inch)	N (cycles)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	Test condition
0.768	86,983	0.00	0.00E+00	Constant $\Delta K = 7.0$ ksi in$^{1/2}$
0.781	207,751	7.06	1.05E-07	
0.786	253,215	7.15	1.09E-07	
0.790	292,819	7.15	1.05E-07	
0.794	335,494	7.14	1.07E-07	
0.800	383,601	7.14	1.09E-07	
0.804	427,052	7.14	1.10E-07	
0.809	465,539	7.14	1.11E-07	
0.814	506,923	7.14	1.13E-07	
0.818	549,963	7.14	1.12E-07	
0.823	594,659	7.13	1.09E-07	
0.828	641,010	7.13	1.06E-07	
0.833	687,360	7.13	1.04E-07	
0.838	733,711	7.13	1.03E-07	
0.842	781,717	7.13	1.02E-07	
0.847	829,724	7.13	1.02E-07	
0.852	877,730	7.13	1.03E-07	
0.857	924,081	7.13	1.05E-07	
0.862	968,776	7.13	1.06E-07	
0.867	1,015,127	7.12	1.06E-07	
0.872	1,061,478	7.12	1.06E-07	
0.877	1,106,173	7.12	1.03E-07	
0.881	1,152,526	7.12	1.00E-07	
0.886	1,202,193	7.12	9.60E-08	
0.891	1,256,827	7.12	8.89E-08	
0.896	1,317,667	7.12	8.09E-08	
0.901	1,385,954	7.12	7.33E-08	
0.906	1,459,415	7.12	6.69E-08	
0.910	1,539,601	7.12	6.20E-08	
0.915	1,625,607	7.11	5.89E-08	
0.920	1,712,902	7.11	5.73E-08	
0.925	1,800,192	7.11	5.74E-08	
0.930	1,881,017	7.11	5.76E-08	
0.935	1,965,074	7.11	5.74E-08	
0.940	2,049,132	7.11	5.65E-08	
0.944	2,129,956	7.11	5.48E-08	
0.949	2,220,480	7.11	5.22E-08	
0.954	2,323,935	7.11	4.95E-08	
0.959	2,431,432	7.11	4.83E-08	
0.964	2,532,462	7.10	4.78E-08	
0.969	2,633,493	7.10	4.77E-08	
0.974	2,738,566	7.10	4.73E-08	
0.979	2,847,681	7.10	4.64E-08	
0.984	2,956,794	7.10	4.53E-08	

0.988	3,057,825	7.10	4.47E-08
0.993	3,162,896	7.10	4.44E-08
0.998	3,272,009	7.10	4.46E-08
1.002	3,381,122	7.10	4.48E-08
1.007	3,490,235	7.10	4.48E-08
1.012	3,595,307	7.10	4.42E-08
1.017	3,708,462	7.09	4.31E-08
1.022	3,829,699	7.09	4.13E-08
1.027	3,954,976	7.09	3.96E-08
1.032	4,085,306	7.09	3.94E-08
1.037	4,206,543	7.09	3.96E-08
1.042	4,322,728	7.09	4.00E-08
1.047	4,449,021	7.09	4.01E-08
1.052	4,570,270	7.09	3.98E-08
1.056	4,686,467	7.09	3.92E-08
1.061	4,812,770	7.09	3.92E-08
1.066	4,944,123	7.09	3.91E-08
1.071	5,065,371	7.09	3.88E-08
1.076	5,186,620	7.09	3.87E-08
1.081	5,312,921	7.08	3.86E-08
1.085	5,439,221	7.08	3.75E-08
1.090	5,575,626	7.08	3.66E-08
1.095	5,717,084	7.08	3.63E-08
1.100	5,853,490	7.08	3.61E-08
1.105	5,984,843	7.08	3.63E-08
1.110	6,116,196	7.08	3.69E-08
1.115	6,247,544	7.08	3.73E-08
1.120	6,378,884	7.08	3.73E-08
1.125	6,505,171	7.08	3.73E-08
1.129	6,631,460	7.08	3.72E-08
1.134	6,767,852	7.08	3.68E-08
1.139	6,904,244	7.08	3.64E-08
1.144	7,035,583	7.07	3.62E-08
1.149	7,171,974	7.07	3.61E-08
1.154	7,308,365	7.07	3.61E-08
1.158	7,439,705	7.07	3.60E-08
1.163	7,576,096	7.07	3.63E-08
1.168	7,712,488	7.07	3.65E-08
1.173	7,843,829	7.07	3.65E-08
1.178	7,975,168	7.07	3.63E-08
1.183	8,111,559	7.07	3.62E-08
1.188	8,253,001	7.07	3.55E-08
1.193	8,389,393	7.07	3.48E-08
1.198	8,525,784	7.07	3.45E-08
1.202	8,672,280	7.07	3.43E-08
1.207	8,818,774	7.07	3.42E-08
1.212	8,960,217	7.07	3.43E-08
1.217	9,101,669	7.06	3.48E-08
1.222	9,238,074	7.06	3.46E-08
1.227	9,374,477	7.06	3.49E-08

1.232	9,510,871	7.06	3.52E-08
1.236	9,652,315	7.06	3.54E-08
1.241	9,793,758	7.06	3.54E-08
1.246	9,925,097	7.06	3.54E-08
1.251	10,066,540	7.06	3.58E-08
1.256	10,202,931	7.06	3.47E-08
1.261	10,334,270	7.06	3.63E-08
1.266	10,475,713	0.00	0.00E+00

APPENDIX D

The fatigue crack growth rate data (d*a*/dN and ΔK) for 4340 steel are listed in Tables D1 through D24 of this appendix sequentially by specimen orientation and number.

Table D1. Constant-K_{max} FCG data for specimen 1 - L-T of 4340 Steel.

Specimen ID:	1			Orientation:	L-T
Test:	K_{max} = 11 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
10.02	1.02E-07	5.60	7.20E-08	2.99	4.30E-09
10.02	1.02E-07	5.14	5.81E-08	2.93	3.64E-09
9.96	9.65E-08	4.68	4.34E-08	2.88	3.17E-09
9.79	9.77E-08	4.28	3.08E-08	2.84	2.78E-09
9.33	9.86E-08	3.93	2.12E-08	2.80	2.53E-09
8.79	9.66E-08	3.64	1.50E-08	2.77	2.31E-09
8.06	8.80E-08	3.42	1.10E-08	2.73	2.07E-09
7.37	8.19E-08	3.26	8.36E-09	2.71	1.92E-09
6.73	7.96E-08	3.15	6.54E-09	2.68	1.45E-09
6.16	7.85E-08	3.06	5.19E-09	2.66	1.66E-09

Table D2. Constant-R (increasing ΔK) FCG data for specimen 1 – L-T of 4340 Steel.

Specimen ID:	1			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
10.08	2.78E-07	13.10	6.05E-07	19.29	2.30E-06
10.08	2.80E-07	13.10	5.95E-07	20.20	2.69E-06
10.08	2.81E-07	13.10	5.96E-07	21.14	3.11E-06
10.08	2.86E-07	13.10	6.02E-07	22.12	3.56E-06
10.10	2.98E-07	13.10	6.19E-07	23.15	4.07E-06
10.29	3.19E-07	13.28	6.55E-07	24.21	4.59E-06
10.55	3.51E-07	13.58	7.12E-07	25.31	5.07E-06
11.00	3.91E-07	14.07	7.99E-07	26.51	5.66E-06
11.50	4.40E-07	14.72	9.14E-07	27.67	6.61E-06
12.03	4.96E-07	15.40	1.06E-06	28.97	8.02E-06
12.59	5.63E-07	16.12	1.23E-06	30.31	9.34E-06
13.17	6.25E-07	16.86	1.42E-06	31.70	1.15E-05
13.78	7.07E-07	17.62	1.66E-06		
13.10	6.01E-07	18.44	1.94E-06		

Table D3. Constant-R (decreasing then increasing ΔK) FCG data for specimen 2 – L-T of 4340 Steel.

Specimen ID:	2			Orientation:	L-T
Test:	R = 0.3				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
10.54	2.81E-07	10.82	3.17E-07	26.97	5.11E-06
10.53	2.80E-07	11.02	3.27E-07	27.46	5.36E-06
10.44	2.78E-07	11.22	3.37E-07	27.95	5.62E-06
10.33	2.70E-07	11.43	3.54E-07	28.46	5.89E-06
10.16	2.61E-07	11.63	3.73E-07	28.97	6.18E-06
9.98	2.50E-07	11.84	3.94E-07	29.49	6.46E-06
9.80	2.36E-07	12.04	4.14E-07	30.03	6.74E-06
9.62	2.23E-07	12.26	4.37E-07	30.57	7.03E-06
9.45	2.08E-07	12.48	4.63E-07	31.13	7.36E-06
9.28	1.93E-07	12.71	4.87E-07	31.68	7.72E-06
9.12	1.77E-07	12.94	5.15E-07	32.25	8.09E-06
8.96	1.60E-07	13.18	5.36E-07	32.84	8.47E-06
8.80	1.44E-07	13.43	5.52E-07	33.42	8.87E-06
8.65	1.28E-07	13.66	5.73E-07	34.03	9.27E-06
8.49	1.15E-07	13.91	5.96E-07	34.65	1.02E-05
8.34	1.04E-07	14.15	6.26E-07	35.28	1.18E-05
8.19	9.45E-08	14.39	6.66E-07	36.49	1.25E-05
8.04	8.56E-08	14.66	7.07E-07	36.59	1.26E-05
7.90	7.60E-08	14.92	7.42E-07	37.81	1.32E-05
7.76	6.58E-08	15.20	7.83E-07	37.92	1.34E-05
7.62	5.66E-08	15.48	8.31E-07	38.60	1.27E-05
7.49	4.93E-08	15.77	8.96E-07	39.30	1.31E-05
7.36	4.39E-08	16.04	9.54E-07	40.02	1.40E-05
7.23	3.96E-08	16.33	1.02E-06	40.74	1.48E-05
7.12	3.65E-08	16.62	1.10E-06	41.48	1.56E-05
7.02	3.40E-08	16.93	1.17E-06	42.20	1.64E-05
6.93	3.16E-08	17.24	1.25E-06	42.96	1.71E-05
6.85	2.93E-08	17.54	1.33E-06	43.74	1.79E-05
6.77	2.70E-08	17.85	1.42E-06	44.52	1.88E-05
6.70	2.43E-08	18.16	1.52E-06	45.34	1.97E-05
6.63	2.15E-08	18.49	1.61E-06	46.17	2.08E-05
6.58	1.92E-08	18.83	1.72E-06	46.99	2.19E-05
6.53	1.72E-08	19.17	1.84E-06	47.86	2.30E-05
6.49	1.61E-08	19.53	1.95E-06	48.71	2.41E-05
6.45	1.54E-08	19.88	2.06E-06	49.58	2.52E-05
6.41	1.50E-08	20.24	2.18E-06	50.49	2.62E-05
6.37	1.48E-08	20.61	2.31E-06	51.40	2.73E-05
6.34	1.47E-08	20.99	2.43E-06	52.33	2.86E-05
6.30	1.41E-08	21.36	2.56E-06	53.27	3.00E-05
6.26	1.31E-08	21.76	2.70E-06	54.25	3.16E-05
6.23	1.24E-08	22.15	2.87E-06	55.22	3.36E-05
6.20	1.17E-08	22.56	3.04E-06	56.24	3.57E-05
6.17	1.13E-08	22.96	3.21E-06	57.25	3.77E-05
6.15	1.09E-08	23.38	3.39E-06	58.26	3.97E-05

6.12	1.04E-08	23.80	3.58E-06	59.31	4.17E-05
6.09	9.77E-09	24.23	3.80E-06	60.36	4.40E-05
6.07	9.36E-09	24.67	3.99E-06	61.47	4.64E-05
6.05	8.95E-09	25.11	4.21E-06	62.58	4.90E-05
10.53	3.09E-07	25.57	4.45E-06	63.70	5.24E-05
10.58	3.09E-07	26.04	4.66E-06	64.86	5.47E-05
10.68	3.11E-07	26.50	4.87E-06		

Table D4. Constant-R (increasing ΔK) FCG data for specimen 3 – L-T of 4340 Steel.

Specimen ID:	3			Orientation:	L-T
Test:	R = 0.3				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
8.91	1.36E-07	14.84	6.52E-07	33.29	8.29E-06
8.75	1.29E-07	15.24	6.98E-07	34.19	8.89E-06
8.60	1.15E-07	15.66	7.48E-07	35.13	9.51E-06
8.45	1.01E-07	16.09	8.06E-07	36.08	1.02E-05
8.30	9.01E-08	16.53	8.75E-07	37.07	1.09E-05
8.15	8.02E-08	16.99	9.56E-07	38.09	1.17E-05
8.01	7.43E-08	17.45	1.05E-06	39.15	1.26E-05
7.72	5.92E-08	17.92	1.17E-06	40.22	1.34E-05
7.50	3.72E-08	18.43	1.29E-06	41.30	1.43E-05
7.42	2.79E-08	18.92	1.42E-06	42.41	1.53E-05
7.36	2.33E-08	19.43	1.57E-06	43.54	1.65E-05
7.29	2.16E-08	19.96	1.73E-06	44.74	1.77E-05
7.23	1.93E-08	20.50	1.91E-06	45.96	1.90E-05
7.18	1.70E-08	21.07	2.11E-06	47.20	2.05E-05
7.13	1.51E-08	21.64	2.32E-06	48.49	2.20E-05
7.09	1.27E-08	22.23	2.55E-06	49.82	2.36E-05
7.06	1.05E-08	22.83	2.78E-06	51.19	2.53E-05
7.03	8.95E-09	23.46	3.03E-06	52.60	2.72E-05
7.01	7.61E-09	24.10	3.32E-06	54.06	2.93E-05
6.99	6.92E-09	24.76	3.61E-06	55.52	3.19E-05
6.97	3.95E-09	25.45	3.93E-06	57.02	3.62E-05
11.64	3.37E-07	26.14	4.27E-06	58.59	4.06E-05
11.96	3.58E-07	26.86	4.64E-06	60.24	4.45E-05
12.29	3.92E-07	27.60	5.03E-06	61.81	4.76E-05
12.63	4.25E-07	28.36	5.44E-06	63.58	5.05E-05
12.98	4.60E-07	29.13	5.89E-06	65.25	5.37E-05
13.33	4.97E-07	29.91	6.34E-06	67.03	5.73E-05
13.70	5.35E-07	30.73	6.79E-06	68.91	6.31E-05
14.07	5.74E-07	31.55	7.25E-06	70.77	6.83E-05
14.45	6.11E-07	32.41	7.77E-06	72.70	7.72E-05

Table D5. Constant-R (increasing ΔK) FCG data for specimen 4 – L-T of 4340 Steel.

Specimen ID:	4			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
7.19	1.11E-07	8.67	1.93E-07	11.16	3.73E-07
7.19	1.15E-07	8.83	2.02E-07	11.36	3.95E-07
7.19	1.14E-07	8.99	2.12E-07	11.57	4.17E-07
7.21	1.16E-07	9.16	2.23E-07	11.78	4.40E-07
7.28	1.21E-07	9.33	2.34E-07	11.99	4.60E-07
7.37	1.25E-07	9.50	2.46E-07	12.21	4.82E-07
7.50	1.31E-07	9.67	2.58E-07	12.43	5.09E-07
7.64	1.37E-07	9.85	2.70E-07	12.66	5.40E-07
7.78	1.44E-07	10.02	2.84E-07	12.89	5.76E-07
7.92	1.52E-07	10.20	2.96E-07	13.12	6.13E-07
8.07	1.60E-07	10.39	3.10E-07	13.36	6.50E-07
8.21	1.68E-07	10.57	3.24E-07	13.60	6.88E-07
8.36	1.77E-07	10.76	3.38E-07	13.85	7.19E-07
8.52	1.85E-07	10.96	3.54E-07		

Table D6. Constant- K_{max} FCG data for specimen 8 – L-T of 4340 Steel.

Specimen ID:	8			Orientation:	L-T
Test:	K_{max} = 15 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
9.98	2.17E-07	6.84	8.53E-08	4.67	3.15E-08
9.82	2.17E-07	6.72	8.15E-08	4.59	2.99E-08
9.67	2.14E-07	6.60	7.77E-08	4.50	2.78E-08
9.50	2.00E-07	6.48	7.42E-08	4.42	2.61E-08
9.32	1.94E-07	6.36	7.05E-08	4.35	2.46E-08
9.15	1.85E-07	6.25	6.72E-08	4.27	2.39E-08
8.99	1.73E-07	6.14	6.49E-08	4.19	2.31E-08
8.82	1.63E-07	6.03	6.31E-08	4.11	2.20E-08
8.66	1.54E-07	5.92	6.17E-08	4.04	2.09E-08
8.51	1.46E-07	5.81	6.04E-08	3.96	1.96E-08
8.35	1.40E-07	5.70	5.67E-08	3.89	1.83E-08
8.20	1.35E-07	5.60	5.27E-08	3.83	1.65E-08
8.06	1.29E-07	4.90	4.84E-08	3.76	1.51E-08
7.91	1.25E-07	5.40	4.46E-08	3.69	1.38E-08
7.77	1.19E-07	4.69	4.17E-08	3.63	1.23E-08
7.63	1.13E-07	5.21	3.99E-08	3.56	1.11E-08
7.49	1.08E-07	5.12	3.93E-08	3.50	1.06E-08
7.36	1.03E-07	5.02	3.79E-08	3.43	9.13E-09
7.23	9.84E-08	4.93	3.59E-08	3.37	8.16E-09
7.10	9.41E-08	4.85	3.43E-08	3.31	7.40E-09
6.97	8.96E-08	4.76	3.29E-08		

Table D7. Constant- K_{max} FCG data for specimen 8 – L-T of 4340 Steel.

Specimen ID:	8			Orientation:	L-T
Test:	K_{max} = 30 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
10.00	2.25E-07	6.73	8.60E-08	4.16	2.90E-08
9.93	2.16E-07	6.61	8.24E-08	4.35	2.80E-08
9.84	2.34E-07	6.49	7.90E-08	4.27	2.73E-08
9.68	2.35E-07	6.37	7.54E-08	4.19	2.61E-08
9.51	2.32E-07	6.26	7.22E-08	4.12	2.47E-08
9.33	2.30E-07	6.15	6.95E-08	4.04	2.36E-08
9.16	2.23E-07	6.04	6.67E-08	3.97	2.28E-08
9.00	2.08E-07	5.93	6.45E-08	3.90	2.16E-08
8.84	1.73E-07	5.82	6.26E-08	3.83	2.05E-08
8.68	1.63E-07	5.71	6.09E-08	3.76	1.92E-08
8.52	1.54E-07	5.61	5.82E-08	3.69	1.77E-08
8.37	1.48E-07	5.51	5.51E-08	3.62	1.68E-08
8.22	1.42E-07	5.41	5.26E-08	3.56	1.47E-08
8.07	1.37E-07	5.31	5.03E-08	3.49	1.31E-08
7.92	1.31E-07	5.22	4.85E-08	3.43	1.14E-08
7.78	1.26E-07	5.13	4.65E-08	3.37	1.05E-08
7.64	1.20E-07	5.03	4.43E-08	3.31	9.82E-09
7.50	1.14E-07	4.94	4.22E-08	3.25	9.89E-09
7.36	1.10E-07	4.85	4.05E-08	3.19	8.92E-09
7.23	1.04E-07	4.76	3.83E-08	3.14	7.15E-09
7.10	9.94E-08	4.68	3.58E-08	3.09	6.18E-09
6.97	9.48E-08	4.32	3.29E-08		
6.85	9.00E-08	4.51	3.05E-08		

Table D8. Constant-R (increasing ΔK) FCG data for specimen 28 – L-T of 4340 Steel.

Specimen ID:	28			Orientation:	L-T
Test:	R = 0.1				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
9.16	1.87E-07	15.57	6.55E-07	40.75	1.43E-05
8.91	1.29E-07	15.99	6.92E-07	41.84	1.51E-05
8.73	8.46E-08	16.42	7.50E-07	43.00	1.62E-05
8.57	5.82E-08	16.85	8.31E-07	44.15	1.74E-05
8.43	4.26E-08	17.33	9.23E-07	45.35	1.86E-05
8.32	3.26E-08	17.78	1.01E-06	46.55	2.00E-05
8.22	2.56E-08	18.27	1.10E-06	47.79	2.14E-05
8.16	2.08E-08	18.77	1.19E-06	49.10	2.30E-05
8.10	1.84E-08	19.27	1.29E-06	50.45	2.47E-05
8.11	1.78E-08	19.80	1.40E-06	51.86	2.66E-05
8.14	1.87E-08	20.34	1.54E-06	53.26	2.85E-05
8.22	2.17E-08	20.89	1.70E-06	54.70	3.08E-05
8.35	2.63E-08	21.46	1.86E-06	56.14	3.34E-05
8.48	3.31E-08	22.03	2.04E-06	57.67	3.62E-05
8.67	4.30E-08	22.63	2.23E-06	59.21	3.95E-05
8.88	5.57E-08	23.24	2.44E-06	60.80	4.27E-05
9.11	6.84E-08	23.87	2.70E-06	62.43	4.59E-05
9.36	8.11E-08	24.51	3.01E-06	64.11	4.93E-05
9.61	9.01E-08	25.19	3.38E-06	65.86	5.33E-05
9.88	9.61E-08	25.88	3.83E-06	67.68	5.72E-05
10.13	1.02E-07	26.60	4.34E-06	69.57	6.16E-05
10.41	1.08E-07	27.31	4.89E-06	71.40	6.77E-05
10.69	1.21E-07	28.06	5.36E-06	73.29	7.58E-05
10.97	1.49E-07	28.80	5.81E-06	75.50	8.36E-05
11.28	1.97E-07	29.56	6.29E-06	77.24	9.02E-05
11.59	2.57E-07	30.38	6.73E-06	79.62	9.81E-05
11.92	3.24E-07	31.19	7.26E-06	81.55	1.06E-04
12.25	3.72E-07	32.04	7.80E-06	83.79	1.16E-04
12.58	3.99E-07	32.93	8.38E-06	86.02	1.33E-04
12.91	4.28E-07	33.83	8.98E-06	88.44	1.52E-04
13.24	4.55E-07	34.73	9.57E-06	90.75	1.70E-04
13.61	4.77E-07	35.67	1.05E-05	93.18	1.90E-04
13.99	5.04E-07	36.63	1.13E-05	95.62	2.15E-04
14.37	5.41E-07	37.66	1.21E-05	98.14	2.30E-04
14.76	5.77E-07	38.64	1.29E-05	100.75	2.69E-04
15.16	6.14E-07	39.74	1.35E-05		

Table D9. Constant-R (decreasing ΔK) FCG data for specimen 30 – L-T of 4340 Steel.

Specimen ID:	30			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
9.55	1.35E-07	8.61	3.18E-08	8.24	1.35E-08
9.39	1.05E-07	8.53	2.62E-08	8.20	1.06E-08
9.24	8.91E-08	8.47	2.21E-08	8.18	8.46E-09
9.09	7.47E-08	8.41	1.93E-08	8.16	6.59E-09
8.95	6.13E-08	8.37	1.77E-08	8.14	6.47E-09
8.82	4.89E-08	8.32	1.64E-08		
8.71	3.90E-08	8.27	1.55E-08		

Table D10. Constant-R (decreasing then increasing ΔK) FCG data for specimen 31 – L-T of 4340 Steel.

Specimen ID:	31			Orientation:	L-T
Test:	R = 0.7				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
8.71	2.03E-07	5.37	5.66E-08	3.42	8.65E-09
8.64	2.00E-07	5.28	5.37E-08	3.39	8.01E-09
8.54	1.98E-07	5.18	5.12E-08	3.37	7.49E-09
8.40	1.94E-07	5.09	4.87E-08	3.34	7.21E-09
8.25	1.89E-07	5.00	4.61E-08	3.32	7.15E-09
8.11	1.79E-07	4.91	4.38E-08	3.30	7.63E-09
7.96	1.70E-07	4.83	4.15E-08	3.29	7.23E-09
7.82	1.61E-07	4.74	3.94E-08	8.77	2.01E-07
7.69	1.53E-07	4.66	3.73E-08	8.80	2.02E-07
7.55	1.46E-07	4.57	3.53E-08	8.86	2.04E-07
7.41	1.41E-07	4.49	3.35E-08	8.99	2.15E-07
7.28	1.35E-07	4.41	3.18E-08	9.18	2.28E-07
7.15	1.29E-07	4.33	2.99E-08	9.45	2.43E-07
7.03	1.22E-07	4.26	2.78E-08	9.71	2.59E-07
6.90	1.16E-07	4.18	2.62E-08	9.98	2.77E-07
6.78	1.09E-07	4.11	2.48E-08	10.25	2.97E-07
6.66	1.03E-07	4.04	2.33E-08	10.53	3.17E-07
6.54	9.74E-08	3.96	2.15E-08	10.81	3.42E-07
6.42	9.23E-08	3.89	1.95E-08	11.11	3.68E-07
6.31	8.75E-08	3.83	1.77E-08	11.41	3.99E-07
6.20	8.31E-08	3.76	1.63E-08	11.72	4.31E-07
6.09	7.88E-08	3.71	1.51E-08	12.05	4.67E-07
5.98	7.47E-08	3.65	1.40E-08	12.38	5.08E-07
5.87	7.15E-08	3.60	1.30E-08	12.72	5.54E-07
5.77	6.91E-08	3.56	1.20E-08	13.07	5.99E-07
5.67	6.64E-08	3.52	1.10E-08	13.44	6.45E-07
5.57	6.32E-08	3.48	1.02E-08	13.81	6.89E-07
5.47	5.99E-08	3.45	9.40E-09	14.19	7.41E-07

Table D11. Constant-R (increasing ΔK) FCG data for specimen 37 – L-T of 4340 Steel.

Specimen ID:	37			Orientation:	L-T
Test:	R = 0.1				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
11.05	2.26E-07	23.20	2.65E-06	49.06	2.17E-05
11.31	2.36E-07	23.91	2.95E-06	50.57	2.30E-05
11.64	2.57E-07	24.64	3.29E-06	52.08	2.47E-05
12.00	2.87E-07	25.41	3.65E-06	53.68	2.67E-05
12.37	3.21E-07	26.18	4.04E-06	55.31	2.96E-05
12.76	3.59E-07	26.97	4.48E-06	56.97	3.28E-05
13.14	3.97E-07	27.78	4.95E-06	58.72	3.59E-05
13.55	4.38E-07	28.61	5.48E-06	60.47	3.90E-05
13.95	4.84E-07	29.48	6.12E-06	62.32	4.21E-05
14.37	5.36E-07	30.39	6.93E-06	64.21	4.54E-05
14.81	5.90E-07	31.32	7.85E-06	66.19	4.97E-05
15.27	6.52E-07	32.29	8.86E-06	68.20	6.50E-05
15.74	7.16E-07	33.26	9.76E-06	70.20	8.10E-05
16.22	7.79E-07	34.28	1.06E-05	72.98	8.70E-05
16.71	8.48E-07	35.29	1.14E-05	74.71	8.56E-05
17.22	9.30E-07	36.37	1.21E-05	77.50	9.16E-05
17.74	1.05E-06	37.46	1.29E-05	79.47	9.16E-05
18.28	1.21E-06	38.62	1.37E-05	81.70	8.59E-05
18.84	1.37E-06	39.81	1.46E-05	84.21	9.98E-05
19.40	1.52E-06	41.04	1.54E-05	86.71	1.14E-04
19.99	1.65E-06	42.28	1.63E-05	89.37	1.31E-04
20.59	1.79E-06	43.55	1.72E-05	91.99	1.50E-04
21.21	1.94E-06	44.89	1.83E-05	94.83	1.70E-04
21.85	2.13E-06	46.21	1.96E-05	97.67	1.94E-04
22.52	2.38E-06	47.64	2.06E-05	100.48	2.11E-04

Table D12. Constant- K_{max} FCG data for specimen 1 – S-T of 4340 Steel.

Specimen ID:	1			Orientation:	S-T
Test:	K_{max} = 15 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
9.16	2.26E-07	4.00	2.49E-08	3.07	5.89E-09
8.40	1.84E-07	3.85	2.20E-08	3.08	5.48E-09
7.70	1.92E-07	3.71	1.94E-08	3.02	5.35E-09
7.05	1.50E-07	3.59	1.78E-08	3.01	5.69E-09
6.45	1.12E-07	3.48	1.55E-08	2.98	4.95E-09
5.92	8.36E-08	3.40	1.33E-08	2.95	5.59E-09
5.41	6.27E-08	3.33	1.16E-08	2.92	5.42E-09
5.04	4.83E-08	3.26	1.03E-08	2.89	5.63E-09
4.68	3.85E-08	3.21	8.15E-09	2.86	4.84E-09
4.41	3.20E-08	3.16	7.63E-09	2.83	5.03E-09
4.21	2.75E-08	3.14	6.55E-09		

Table D13. Constant- K_{max} FCG data for specimen 1 – S-T of 4340 Steel.

Specimen ID:	1			Orientation:	S-T
Test:	K_{max} = 30 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
14.94	8.20E-07	8.34	2.09E-07	4.06	3.24E-08
14.60	7.98E-07	7.61	1.66E-07	3.71	2.23E-08
14.00	7.69E-07	6.98	1.31E-07	3.44	1.57E-08
13.10	6.90E-07	6.37	1.05E-07	3.23	1.17E-08
11.96	5.63E-07	5.83	8.46E-08	3.07	9.09E-09
10.94	4.33E-07	5.33	7.02E-08	2.94	7.51E-09
9.98	3.38E-07	4.87	5.87E-08	2.86	5.39E-09
9.13	2.65E-07	4.44	4.56E-08		

Table D14. Constant-K_{max} FCG data for for specimen 1 – S-T of 4340 Steel.

Specimen ID:	1			Orientation:	S-T
Test:	K_{max} = 45 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
14.42	8.37E-07	5.67	8.36E-08	2.72	5.35E-09
13.81	8.06E-07	5.18	6.79E-08	2.66	4.35E-09
12.74	6.96E-07	4.73	5.34E-08	2.61	3.54E-09
11.66	5.49E-07	4.33	4.31E-08	2.57	2.92E-09
10.65	4.24E-07	3.98	3.43E-08	2.53	2.50E-09
9.73	3.40E-07	3.67	2.60E-08	2.51	2.22E-09
8.88	2.70E-07	3.42	1.88E-08	2.48	2.03E-09
8.12	2.14E-07	3.21	1.34E-08	2.46	1.90E-09
7.42	1.67E-07	3.04	1.00E-08	2.43	1.93E-09
6.79	1.31E-07	2.91	7.96E-09	2.41	1.81E-09
6.20	1.04E-07	2.81	6.51E-09		

Table D15. Constant-K_{max} FCG data for for specimen 4 – S-T of 4340 Steel.

Specimen ID:	4			Orientation:	S-T
Test:	K_{max} = 11 ksi in$^{1/2}$				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
9.94	1.62E-07	5.52	4.65E-08	3.00	5.73E-09
9.80	1.45E-07	5.04	3.58E-08	2.98	5.04E-09
9.27	1.47E-07	4.60	2.73E-08	2.96	4.09E-09
8.76	1.50E-07	4.21	2.04E-08	2.94	3.45E-09
7.89	1.26E-07	3.84	1.45E-08	2.92	3.23E-09
7.21	9.52E-08	3.51	9.17E-09	2.90	3.29E-09
6.60	7.44E-08	3.26	6.57E-09		
6.02	5.90E-08	3.10	5.64E-09		

Table D16. Constant-R (increasing ΔK) FCG data for specimen 4 – S-T of 4340 Steel.

Specimen ID:	4			Orientation:	S-T
Test:	R = 0.3				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
9.92	2.45E-07	19.92	2.07E-06	42.27	1.70E-05
10.07	2.50E-07	20.46	2.29E-06	43.45	1.81E-05
10.32	2.71E-07	21.02	2.49E-06	44.62	1.97E-05
10.60	3.05E-07	21.59	2.70E-06	45.84	2.10E-05
11.00	3.32E-07	22.19	2.94E-06	47.07	2.24E-05
11.31	3.56E-07	22.79	3.19E-06	48.33	2.40E-05
11.62	3.84E-07	23.41	3.47E-06	49.66	2.62E-05
11.94	4.13E-07	24.03	3.80E-06	51.00	2.81E-05
12.26	4.33E-07	24.68	4.12E-06	52.40	2.97E-05
12.59	4.73E-07	25.36	4.39E-06	53.79	3.15E-05
12.94	5.22E-07	26.06	4.84E-06	55.28	3.31E-05
13.30	5.54E-07	26.79	5.33E-06	56.80	3.60E-05
13.67	5.92E-07	28.25	5.65E-06	58.34	3.88E-05
14.05	6.41E-07	29.78	6.96E-06	59.94	4.15E-05
14.43	6.99E-07	30.62	7.44E-06	61.56	4.54E-05
14.81	7.52E-07	31.45	7.95E-06	63.21	4.97E-05
15.22	8.14E-07	32.31	8.56E-06	64.95	5.48E-05
15.63	9.11E-07	33.19	9.23E-06	66.73	5.99E-05
16.06	9.91E-07	34.08	9.73E-06	68.54	6.55E-05
16.50	1.06E-06	35.00	1.04E-05	70.36	7.14E-05
16.95	1.15E-06	35.97	1.11E-05	72.35	7.93E-05
17.40	1.26E-06	36.97	1.19E-05	74.20	8.67E-05
17.87	1.40E-06	37.97	1.27E-05	76.46	9.73E-05
18.36	1.53E-06	39.03	1.36E-05	78.58	1.37E-04
18.87	1.68E-06	40.07	1.48E-05		
19.39	1.86E-06	41.14	1.61E-05		

Table D17. Constant-R (decreasing then increasing ΔK) FCG data for specimen 5 – S-T of 4340 Steel.

Specimen ID:	5			Orientation:	S-T
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
6.52	9.62E-08	3.54	1.09E-08	8.78	1.93E-07
6.51	9.46E-08	3.52	1.05E-08	8.94	2.03E-07
6.46	9.26E-08	3.51	1.00E-08	9.10	2.14E-07
6.39	8.87E-08	3.50	9.52E-09	9.27	2.25E-07
6.28	8.46E-08	3.48	9.14E-09	9.44	2.37E-07
6.17	8.17E-08	3.47	9.01E-09	9.62	2.49E-07
6.06	7.77E-08	3.46	9.02E-09	9.80	2.61E-07
5.95	7.36E-08	3.45	9.09E-09	9.99	2.72E-07
5.85	6.94E-08	3.44	8.96E-09	10.17	2.85E-07
5.74	6.53E-08	3.42	8.90E-09	10.36	2.99E-07
5.64	6.21E-08	3.41	8.59E-09	10.55	3.12E-07
5.54	5.97E-08	3.40	7.78E-09	10.74	3.30E-07
5.44	5.74E-08	3.39	6.96E-09	10.93	3.50E-07
5.35	5.53E-08	3.38	6.65E-09	11.13	3.71E-07
5.25	5.33E-08	3.37	6.17E-09	11.34	3.90E-07
5.16	5.11E-08	3.36	6.02E-09	11.55	4.12E-07
5.07	4.86E-08	3.36	5.95E-09	11.76	4.34E-07
4.98	4.63E-08	3.35	6.26E-09	11.98	4.54E-07
4.89	4.37E-08	3.34	5.61E-09	12.20	4.78E-07
4.80	4.04E-08	3.33	4.83E-09	12.43	5.05E-07
4.72	3.73E-08	3.33	4.43E-09	12.66	5.37E-07
4.63	3.47E-08	3.32	3.99E-09	12.90	5.69E-07
4.55	3.24E-08	3.32	4.16E-09	13.14	6.02E-07
4.47	3.03E-08	3.31	4.34E-09	13.38	6.37E-07
4.39	2.83E-08	3.31	5.10E-09	13.62	6.72E-07
4.31	2.61E-08	3.30	5.29E-09	13.88	7.05E-07
4.24	2.42E-08	3.29	5.35E-09	14.13	7.40E-07
4.16	2.22E-08	3.29	5.20E-09	14.40	7.80E-07
4.09	2.04E-08	3.28	4.98E-09	14.67	8.24E-07
4.02	1.87E-08	3.27	4.73E-09	14.94	8.71E-07
3.94	1.72E-08	3.27	4.46E-09	15.22	9.24E-07
3.87	1.58E-08	3.26	4.34E-09	15.50	9.83E-07
3.80	1.45E-08	3.26	4.37E-09	15.79	1.04E-06
3.74	1.19E-08	3.25	4.43E-09	16.07	1.11E-06
3.67	1.02E-08	3.24	4.50E-09	16.38	1.17E-06
3.98	2.16E-08	3.24	4.64E-09	16.68	1.25E-06
3.98	2.07E-08	3.23	4.55E-09	16.98	1.33E-06
3.98	2.06E-08	3.23	4.24E-09	17.30	1.42E-06
3.98	2.05E-08	3.22	4.26E-09	17.61	1.51E-06
3.98	2.04E-08	3.22	4.51E-09	17.93	1.61E-06
3.97	2.03E-08	3.21	4.57E-09	18.27	1.72E-06
3.96	2.01E-08	3.20	4.16E-09	18.61	1.83E-06
3.94	1.97E-08	3.19	3.87E-09	18.95	1.94E-06
3.91	1.92E-08	6.43	8.77E-08	19.31	2.07E-06

3.88	1.85E-08	6.48	8.52E-08	19.67	2.25E-06
3.85	1.78E-08	6.55	9.12E-08	20.02	2.47E-06
3.82	1.70E-08	6.67	9.48E-08	20.41	2.64E-06
3.80	1.63E-08	6.79	9.95E-08	20.77	2.79E-06
3.77	1.57E-08	6.92	1.05E-07	21.16	2.95E-06
3.75	1.51E-08	7.05	1.09E-07	21.56	3.12E-06
3.73	1.46E-08	7.18	1.13E-07	21.96	3.28E-06
3.71	1.40E-08	7.31	1.07E-07	22.37	3.45E-06
3.69	1.35E-08	7.44	1.06E-07	22.79	3.64E-06
3.67	1.28E-08	7.55	1.02E-07	23.20	3.64E-06
3.65	1.22E-08	7.72	1.07E-07	23.63	3.79E-06
3.64	1.18E-08	7.83	1.29E-07	24.01	4.07E-06
3.62	1.15E-08	8.01	1.45E-07	24.54	4.60E-06
3.60	1.14E-08	8.16	1.59E-07	24.92	5.06E-06
3.59	1.15E-08	8.31	1.69E-07	25.44	5.29E-06
3.57	1.15E-08	8.46	1.77E-07	25.91	5.39E-06
3.55	1.12E-08	8.62	1.84E-07	26.39	5.66E-06

Table D18. Constant-R (decreasing then increasing ΔK) FCG data for specimen 8 S – T of 4340 Steel.

Specimen ID:	8			Orientation:	S-T
Test:	R = 0.1				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
8.50	2.12E-08	15.15	5.81E-07	35.01	9.56E-06
7.75	4.31E-09	15.42	6.10E-07	35.64	1.01E-05
7.72	1.13E-09	15.70	6.40E-07	36.31	1.06E-05
7.68	5.33E-09	16.00	6.72E-07	36.91	1.12E-05
7.64	4.49E-09	16.29	7.06E-07	37.62	1.17E-05
7.62	4.15E-09	16.59	7.39E-07	38.26	1.21E-05
7.58	3.82E-09	16.89	7.76E-07	38.99	1.27E-05
7.56	4.36E-09	17.19	8.16E-07	39.69	1.33E-05
7.54	3.54E-09	17.51	8.59E-07	40.44	1.39E-05
8.34	1.34E-08	17.83	9.05E-07	41.11	1.44E-05
8.39	1.39E-08	18.15	9.58E-07	41.89	1.51E-05
8.43	1.39E-08	18.48	1.02E-06	42.63	1.58E-05
8.48	1.44E-08	18.82	1.08E-06	43.44	1.66E-05
8.53	1.51E-08	19.17	1.15E-06	44.21	1.73E-05
8.58	1.61E-08	19.51	1.22E-06	45.07	1.79E-05
8.64	1.81E-08	19.87	1.31E-06	45.83	1.90E-05
8.70	2.11E-08	20.23	1.40E-06	46.71	2.00E-05
8.78	2.57E-08	20.60	1.50E-06	47.56	2.09E-05
8.87	3.09E-08	20.98	1.62E-06	48.41	2.16E-05
9.00	3.68E-08	21.36	1.74E-06	49.30	2.28E-05
9.14	4.37E-08	21.74	1.89E-06	50.18	2.40E-05
9.30	5.10E-08	21.51	1.77E-06	51.09	2.51E-05
9.47	5.87E-08	21.88	1.89E-06	52.00	2.61E-05
9.64	6.62E-08	22.30	1.97E-06	52.95	2.73E-05
9.82	7.44E-08	22.72	2.11E-06	53.91	2.84E-05
9.99	8.32E-08	23.12	2.30E-06	54.88	2.97E-05
10.18	9.40E-08	23.58	2.46E-06	55.88	3.16E-05
10.36	1.07E-07	23.97	2.61E-06	56.92	3.39E-05
10.56	1.19E-07	24.40	2.75E-06	57.96	3.62E-05
10.75	1.33E-07	24.82	2.96E-06	59.02	3.82E-05
10.94	1.48E-07	25.25	3.14E-06	60.10	4.00E-05
11.14	1.66E-07	25.73	3.38E-06	61.18	4.19E-05
11.35	1.85E-07	26.20	3.63E-06	62.30	4.34E-05
11.56	2.06E-07	26.70	3.89E-06	63.40	4.54E-05
11.77	2.30E-07	27.18	4.21E-06	64.54	4.77E-05
11.99	2.52E-07	27.69	4.46E-06	65.70	5.05E-05
12.21	2.74E-07	28.18	4.73E-06	66.89	5.39E-05
12.42	2.95E-07	28.70	5.03E-06	68.13	5.77E-05
12.65	3.15E-07	29.26	5.28E-06	69.38	6.20E-05
12.87	3.35E-07	29.78	5.62E-06	70.62	6.65E-05
13.11	3.54E-07	30.32	5.93E-06	71.90	7.07E-05
13.35	3.77E-07	30.87	6.32E-06	73.18	7.50E-05
13.59	4.02E-07	31.40	6.75E-06	74.50	7.96E-05
13.84	4.30E-07	31.98	7.23E-06	75.87	8.39E-05

14.09	4.59E-07	32.55	7.69E-06	77.22	8.73E-05
14.35	4.90E-07	33.14	8.00E-06	78.62	9.02E-05
14.61	5.22E-07	33.75	8.47E-06	80.02	9.25E-05
14.88	5.52E-07	34.36	8.90E-06	81.47	9.36E-05

Table D19. Constant-R (increasing ΔK) FCG data for specimen 12 S – T of 4340 Steel.

Specimen ID:	12			Orientation:	S-T
Test:	R = 0.3				
ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)
10.36	2.69E-07	21.05	2.63E-06	43.73	1.85E-05
10.50	2.78E-07	21.63	2.89E-06	44.92	1.98E-05
10.68	2.97E-07	22.22	3.15E-06	46.16	2.11E-05
10.96	3.22E-07	22.84	3.42E-06	47.41	2.26E-05
11.27	3.52E-07	23.44	3.69E-06	48.72	2.43E-05
11.58	3.85E-07	24.08	3.99E-06	50.06	2.61E-05
11.90	4.20E-07	24.74	4.31E-06	51.43	2.80E-05
12.23	4.55E-07	25.43	4.66E-06	52.84	3.02E-05
12.56	4.93E-07	26.14	5.06E-06	54.25	3.24E-05
12.91	5.34E-07	26.87	5.50E-06	55.78	3.48E-05
13.27	5.81E-07	27.61	5.96E-06	57.28	3.76E-05
13.64	6.31E-07	28.37	6.42E-06	58.90	4.06E-05
14.02	6.85E-07	29.14	6.86E-06	60.49	4.41E-05
14.41	7.46E-07	29.93	7.31E-06	62.23	4.78E-05
14.79	8.16E-07	30.75	7.77E-06	63.86	5.18E-05
15.20	8.89E-07	31.60	8.30E-06	65.67	5.61E-05
15.60	9.64E-07	32.45	8.90E-06	67.39	6.13E-05
16.03	1.06E-06	33.34	9.50E-06	69.24	6.67E-05
16.49	1.16E-06	34.25	1.01E-05	71.14	7.28E-05
16.94	1.27E-06	35.19	1.08E-05	73.10	7.91E-05
17.40	1.40E-06	36.16	1.16E-05	75.14	8.51E-05
17.88	1.53E-06	37.17	1.24E-05	83.71	1.28E-04
18.37	1.68E-06	38.20	1.33E-05	85.98	1.48E-04
18.88	1.84E-06	39.25	1.43E-05	88.32	1.66E-04
19.41	2.01E-06	40.34	1.52E-05	90.70	1.88E-04
19.94	2.20E-06	41.43	1.61E-05		
20.49	2.41E-06	42.56	1.72E-05		

Table D20. Constant-R (decreasing ΔK) FCG data for specimen 16 S – T of 4340 Steel.

Specimen ID:	16			Orientation:	S-T
Test:	R = 0.3				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
9.70	3.58E-07	7.16	2.73E-08	6.62	8.73E-09
9.56	3.33E-07	7.11	2.49E-08	6.60	7.82E-09
9.41	3.22E-07	7.06	2.25E-08	6.59	7.60E-09
9.27	3.03E-07	7.02	1.85E-08	6.58	7.63E-09
9.12	2.87E-07	6.99	1.35E-08	6.56	7.60E-09
8.98	2.71E-07	6.97	1.18E-08	6.55	7.49E-09
8.84	2.51E-07	6.94	1.13E-08	6.54	7.39E-09
8.71	2.37E-07	6.93	1.05E-08	6.52	7.38E-09
8.57	2.13E-07	6.90	1.10E-08	6.51	7.36E-09
8.31	1.36E-07	6.88	1.25E-08	6.49	7.30E-09
8.05	1.01E-07	6.86	1.34E-08	6.48	7.15E-09
7.93	9.53E-08	6.83	1.46E-08	6.47	6.92E-09
7.80	8.83E-08	6.80	1.55E-08	6.46	6.59E-09
7.68	7.23E-08	6.77	1.58E-08	6.44	6.04E-09
7.56	5.83E-08	6.74	1.56E-08	6.43	5.27E-09
7.45	4.77E-08	6.71	1.48E-08	6.42	4.44E-09
7.36	3.94E-08	6.68	1.35E-08	6.42	2.79E-09
7.28	3.50E-08	6.66	1.14E-08	6.41	1.89E-09
7.23	3.12E-08	6.64	1.00E-08		

Table D21. Constant-R (increasing ΔK) FCG data for specimen 1 T – L of 4340 Steel.

Specimen ID:	1			Orientation:	T-L
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
5.85	7.01E-08	9.32	2.37E-07	13.41	6.79E-07
5.89	7.40E-08	9.49	2.49E-07	13.65	7.16E-07
6.00	8.32E-08	9.66	2.62E-07	13.90	7.58E-07
6.11	9.00E-08	9.84	2.75E-07	14.16	8.05E-07
6.22	9.62E-08	10.02	2.90E-07	14.42	8.56E-07
6.34	1.03E-07	10.20	3.05E-07	14.69	9.09E-07
6.46	1.09E-07	10.39	3.19E-07	14.96	9.63E-07
6.58	1.16E-07	10.58	3.33E-07	15.24	1.02E-06
6.70	1.20E-07	10.77	3.46E-07	15.51	1.08E-06
6.82	1.24E-07	10.97	3.58E-07	15.79	1.15E-06
6.95	1.27E-07	11.17	3.69E-07	16.08	1.22E-06
7.08	1.28E-07	11.38	3.72E-07	16.38	1.29E-06
7.21	1.29E-07	11.07	3.74E-07	16.68	1.37E-06
7.34	1.32E-07	11.19	3.74E-07	16.99	1.46E-06
7.48	1.35E-07	10.86	3.75E-07	17.29	1.56E-06
7.62	1.40E-07	10.97	3.81E-07	17.61	1.66E-06
7.76	1.45E-07	11.18	3.95E-07	17.93	1.77E-06
7.90	1.51E-07	11.38	4.15E-07	18.26	1.88E-06
8.05	1.58E-07	11.59	4.36E-07	18.59	1.99E-06
8.19	1.65E-07	11.80	4.60E-07	18.94	2.11E-06
8.35	1.74E-07	12.02	4.85E-07	19.28	2.23E-06
8.50	1.83E-07	12.24	5.13E-07	19.64	2.38E-06
8.66	1.92E-07	12.47	5.45E-07	20.01	2.59E-06
8.82	2.03E-07	12.70	5.77E-07	20.38	2.86E-06
8.98	2.14E-07	12.93	6.10E-07	20.76	3.13E-06
9.15	2.25E-07	13.17	6.44E-07		

Table D22. Constant- K_{max} FCG data for specimen 2 T – L of 4340 Steel.

Specimen ID:	2			Orientation:	T-L
Test:	K_{max} = 11 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
9.40	1.61E-07	5.02	3.54E-08	3.63	7.57E-09
9.01	1.51E-07	4.68	3.02E-08	3.56	1.64E-08
8.28	1.19E-07	4.45	3.31E-08	3.50	8.23E-09
7.52	9.17E-08	4.25	3.19E-08	3.19	1.22E-09
6.86	7.29E-08	4.11	2.27E-08	3.18	3.02E-09
6.31	6.52E-08	3.90	1.98E-08	3.15	2.18E-09
5.81	5.43E-08	3.88	1.77E-08		
5.35	4.33E-08	3.72	9.50E-09		

Table D23. Constant- K_{max} FCG data for specimen 2 T – L of 4340 Steel.

Specimen ID:	2			Orientation:	T-L
Test:	K_{max} = 15 ksi $in^{1/2}$				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
8.83	1.53E-07	6.76	1.06E-07	5.14	5.40E-08
8.07	1.25E-07	6.16	8.62E-08	4.31	2.18E-08
7.39	1.04E-07	5.63	6.98E-08	3.78	1.14E-08

Table D24. Constant-R (decreasing then increasing ΔK) FCG data for specimen 6 T – L of 4340 Steel.

Specimen ID:	6			Orientation:	T-L
Test:	R = 0.7				
ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)
7.25	1.21E-07	3.52	1.12E-08	9.57	2.13E-07
7.18	1.20E-07	3.50	1.06E-08	9.75	2.24E-07
7.06	1.17E-07	3.49	1.02E-08	9.93	2.36E-07
6.94	1.13E-07	3.48	9.82E-09	10.11	2.48E-07
6.82	1.08E-07	3.46	9.45E-09	10.30	2.61E-07
6.70	1.03E-07	3.45	9.11E-09	10.49	2.75E-07
6.59	9.82E-08	3.44	9.02E-09	10.68	2.90E-07
6.47	9.45E-08	3.43	8.73E-09	10.88	3.07E-07
6.36	9.10E-08	3.42	8.36E-09	11.08	3.24E-07
6.25	8.74E-08	3.41	8.08E-09	11.29	3.42E-07
6.14	8.35E-08	3.40	7.83E-09	11.50	3.61E-07
6.03	7.96E-08	3.39	7.54E-09	11.71	3.81E-07
5.93	7.57E-08	3.38	7.14E-09	11.93	4.03E-07
5.83	7.22E-08	3.37	6.96E-09	12.15	4.24E-07
5.73	6.90E-08	3.36	6.74E-09	12.37	4.45E-07
5.63	6.57E-08	3.35	6.53E-09	12.60	4.71E-07
5.53	6.23E-08	3.34	6.23E-09	12.83	4.96E-07
5.44	5.90E-08	3.34	5.99E-09	13.07	5.23E-07
5.34	5.62E-08	3.33	5.74E-09	13.31	5.53E-07
5.25	5.35E-08	3.32	5.61E-09	13.56	5.85E-07
5.16	5.09E-08	3.32	5.56E-09	13.81	6.18E-07
5.07	4.83E-08	3.31	5.53E-09	14.07	6.54E-07
4.98	4.56E-08	3.30	5.48E-09	14.32	6.92E-07
4.90	4.31E-08	3.29	5.33E-09	14.59	7.34E-07
4.82	4.08E-08	3.29	5.22E-09	14.86	7.83E-07
4.75	3.87E-08	3.28	5.13E-09	15.13	8.34E-07
4.69	3.69E-08	3.28	5.11E-09	15.41	8.70E-07
4.63	3.54E-08	3.27	5.11E-09	15.70	9.07E-07
4.57	3.42E-08	3.26	5.08E-09	15.99	9.69E-07
4.51	3.31E-08	3.26	4.94E-09	16.28	1.08E-06
4.46	3.20E-08	3.25	4.77E-09	16.59	1.24E-06
4.40	3.10E-08	3.25	4.50E-09	16.90	1.35E-06
4.35	3.00E-08	3.24	4.31E-09	17.21	1.45E-06

4.31	2.90E-08	3.24	4.23E-09	17.53	1.54E-06
4.26	2.82E-08	3.23	4.27E-09	17.85	1.58E-06
4.22	2.73E-08	3.23	4.24E-09	18.18	1.63E-06
4.18	2.64E-08	3.22	4.21E-09	18.52	1.70E-06
4.14	2.52E-08	3.21	4.26E-09	18.86	1.80E-06
4.10	2.40E-08	3.21	4.27E-09	19.20	1.91E-06
4.06	2.28E-08	3.20	4.32E-09	19.56	2.03E-06
4.03	2.19E-08	3.20	4.38E-09	19.92	2.16E-06
4.00	2.11E-08	3.19	4.31E-09	20.29	2.30E-06
3.97	2.02E-08	3.19	4.32E-09	20.67	2.45E-06
3.94	1.94E-08	3.18	4.44E-09	21.04	2.61E-06
3.91	1.87E-08	3.18	4.35E-09	21.44	2.75E-06
3.88	1.79E-08	3.17	4.28E-09	21.83	2.89E-06
3.86	1.73E-08	3.17	4.23E-09	22.24	3.04E-06
3.83	1.69E-08	3.16	4.08E-09	22.65	3.19E-06
3.81	1.67E-08	3.16	3.66E-09	23.06	3.37E-06
3.79	1.65E-08	3.15	3.27E-09	23.49	3.57E-06
3.76	1.62E-08	3.15	3.22E-09	23.92	3.98E-06
3.74	1.57E-08	3.15	3.06E-09	24.37	4.37E-06
3.72	1.50E-08	7.68	1.23E-07	24.15	4.40E-06
3.70	1.42E-08	7.82	1.27E-07	24.60	4.16E-06
3.68	1.34E-08	7.97	1.33E-07	25.06	4.27E-06
3.66	1.28E-08	8.12	1.39E-07	25.53	4.52E-06
3.64	1.24E-08	8.27	1.45E-07	26.01	4.82E-06
3.63	1.22E-08	8.42	1.52E-07	26.50	4.63E-06
3.61	1.21E-08	8.57	1.59E-07	27.00	4.93E-06
3.60	1.21E-08	8.73	1.66E-07	27.37	5.45E-06
3.58	1.21E-08	8.89	1.74E-07	28.02	6.39E-06
3.56	1.22E-08	9.06	1.82E-07	28.42	7.23E-06
3.55	1.21E-08	9.22	1.92E-07	29.07	8.82E-06
3.53	1.17E-08	9.40	2.01E-07		

APPENDIX E

The fatigue crack growth rate data (a, N, da/dN and ΔK) of 4340 steel alloy are listed in Tables E1 and E2 of this appendix sequentially by specimen orientation and number.

Table E1. Crack growth data for specimen number 9 - L-T of 4340 Steel.

Specimen ID:	9		Orientation:	L-T
Test:	Constant ΔK = 5.89 ksi $in^{1/2}$ Constant ΔK = 9.81 ksi $in^{1/2}$ Constant R = 0.1 Load Reduction			

a (inch)	N (cycles)	ΔK (ksi $in^{1/2}$)	da/dN (inch/cycle)	Test condition
0.758	71,069	0.00	0.00E+00	Constant ΔK = 5.89 ksi $in^{1/2}$
0.766	143,617	5.89	5.77E-08	
0.772	315,091	5.89	3.45E-08	
0.779	514,908	5.89	3.83E-08	
0.785	714,952	5.89	3.04E-08	
0.791	914,958	5.89	2.89E-08	
0.796	1,114,983	5.89	2.84E-08	
0.801	1,314,962	5.89	2.82E-08	
0.807	1,515,027	5.89	2.83E-08	
0.813	1,715,179	5.89	2.84E-08	
0.819	1,915,236	5.89	2.83E-08	
0.825	2,115,078	5.89	2.79E-08	
0.830	2,314,903	5.89	2.76E-08	
0.835	2,515,103	5.89	2.77E-08	
0.841	2,715,213	5.89	2.75E-08	
0.846	2,915,676	5.89	2.72E-08	
0.852	3,115,844	5.89	2.70E-08	
0.857	3,315,297	5.89	2.65E-08	
0.862	3,516,075	5.89	2.58E-08	
0.868	3,716,915	5.89	2.62E-08	
0.873	3,917,567	5.89	2.71E-08	
0.878	4,116,908	5.89	2.76E-08	
0.884	4,318,171	5.89	2.75E-08	
0.890	4,519,254	5.89	2.73E-08	
0.895	4,718,664	5.89	2.68E-08	
0.900	4,920,684	5.89	2.65E-08	
0.905	5,122,705	5.89	2.73E-08	
0.911	5,319,675	5.89	2.86E-08	
0.917	5,516,644	5.89	3.00E-08	
0.923	5,718,664	5.89	3.04E-08	
0.929	5,920,684	5.89	2.91E-08	
0.936	6,122,705	5.89	2.65E-08	
0.941	6,319,675	5.89	2.30E-08	
0.945	6,516,644	5.89	1.92E-08	
0.948	6,718,664	5.89	1.60E-08	

0.950	6,920,684	5.89	1.40E-08	
0.953	7,122,705	5.89	1.29E-08	
0.956	7,319,675	5.89	1.17E-08	
0.958	7,516,644	5.89	1.08E-08	
0.960	7,718,664	5.89	9.67E-09	
0.961	7,920,684	5.89	6.40E-09	
0.963	8,320,267	5.89	5.30E-09	
0.965	8,722,613	5.89	8.57E-09	
0.962	8,919,583	5.89	1.31E-08	
0.965	9,116,552	5.89	1.87E-08	
0.968	9,318,572	5.89	2.10E-08	
0.970	9,520,592	5.89	1.54E-08	
0.974	9,722,613	5.89	8.12E-09	
0.980	9,919,583	5.89	2.23E-09	
0.986	10,116,555	5.89	-1.89E-09	
0.989	10,318,575	5.88	-2.10E-09	
0.980	10,520,595	5.89	2.34E-09	
0.979	10,722,616	5.89	9.76E-09	
0.981	10,919,586	5.89	1.11E-08	
0.983	11,116,555	5.89	1.03E-08	
0.986	11,318,575	5.89	1.04E-08	
0.988	11,520,595	5.89	1.94E-08	
1.016	11,957,358	9.81	1.84E-07	Constant ΔK = 9.81 ksi in$^{1/2}$
1.025	11,999,594	9.81	2.07E-07	
1.034	12,044,738	9.81	2.04E-07	
1.043	12,089,751	9.81	2.00E-07	
1.052	12,134,452	9.81	1.97E-07	
1.061	12,180,695	9.81	1.93E-07	
1.070	12,228,479	9.81	1.89E-07	
1.079	12,276,262	9.81	1.86E-07	
1.088	12,324,432	9.81	1.82E-07	
1.097	12,372,601	9.81	1.76E-07	
1.106	12,424,624	9.81	1.70E-07	
1.115	12,482,427	9.81	1.65E-07	
1.124	12,540,230	9.81	1.62E-07	
1.133	12,596,106	9.81	1.59E-07	
1.142	12,650,055	9.81	1.59E-07	
1.151	12,705,932	9.81	1.62E-07	
1.160	12,765,662	9.81	1.96E-07	
1.196	12,909,213	9.80	2.81E-07	Constant R = 0.1 Load Reduction
1.205	12,968,943	9.80	2.34E-07	
1.213	13,035,420	9.80	1.46E-07	
1.222	13,105,270	9.78	1.28E-07	
1.232	13,182,347	9.70	1.19E-07	
1.241	13,268,453	9.60	1.11E-07	
1.249	13,370,813	9.43	9.33E-08	
1.258	13,510,804	9.27	7.02E-08	
1.267	13,697,082	9.11	4.86E-08	
1.275	13,901,580	8.98	3.26E-08	
1.280	14,103,600	8.89	2.29E-08	

1.282	14,305,621	8.82	1.75E-08
1.284	14,507,642	8.78	1.49E-08
1.287	14,709,662	8.73	1.50E-08
1.291	14,906,631	8.67	1.63E-08
1.294	15,103,600	8.61	1.70E-08
1.298	15,305,621	8.55	1.65E-08
1.301	15,507,642	8.49	1.54E-08
1.304	15,709,662	8.44	1.43E-08
1.306	15,906,631	8.40	1.34E-08
1.309	16,103,600	8.35	1.25E-08
1.312	16,305,621	8.31	1.19E-08
1.314	16,507,642	8.27	1.17E-08
1.316	16,709,662	8.23	1.15E-08
1.318	16,906,630	8.20	1.15E-08
1.321	17,103,600	8.16	1.17E-08
1.323	17,305,622	8.12	1.19E-08
1.325	17,507,642	8.08	1.18E-08
1.328	17,709,662	8.04	1.16E-08
1.330	17,906,630	8.00	1.13E-08
1.332	18,103,600	7.97	1.07E-08
1.335	18,305,622	7.94	1.02E-08
1.336	18,507,642	7.90	9.81E-09
1.338	18,709,662	7.87	9.40E-09
1.340	18,906,630	7.85	9.05E-09
1.342	19,103,600	7.82	8.86E-09
1.344	19,305,622	7.79	8.68E-09
1.345	19,507,642	7.76	8.45E-09
1.347	19,709,662	7.74	8.22E-09
1.349	19,906,630	7.71	7.91E-09
1.350	20,103,600	7.69	7.67E-09
1.352	20,305,622	7.66	7.31E-09
1.353	20,507,642	7.64	7.00E-09
1.355	20,709,662	7.62	6.82E-09
1.356	20,906,630	7.60	6.77E-09
1.357	21,103,600	7.58	6.57E-09
1.359	21,305,622	7.56	6.33E-09
1.360	21,507,642	7.54	6.15E-09
1.361	21,709,662	7.52	6.00E-09
1.362	21,906,630	7.51	5.63E-09
1.363	22,103,600	7.49	5.27E-09
1.364	22,305,622	7.47	4.89E-09
1.365	22,507,642	7.46	4.39E-09
1.366	22,709,662	7.45	4.17E-09
1.367	22,906,630	7.43	3.86E-09
1.368	23,103,600	7.42	3.92E-09
1.369	23,305,622	7.41	3.90E-09
1.369	23,507,642	7.40	3.78E-09
1.370	23,709,662	7.39	3.58E-09
1.371	23,906,630	7.38	3.28E-09
1.371	24,103,600	7.37	3.02E-09

1.372	24,305,622	7.36	2.61E-09
1.372	24,507,642	7.35	2.17E-09
1.373	24,709,662	7.35	2.11E-09
1.373	24,906,630	0.00	0.00E+00

Table E2. Crack growth data for specimen number 25 - L-T of 4340 Steel.

Specimen ID:	25		Orientation:	L-T
Test:	Constant $\Delta K = 5.90$ ksi in$^{1/2}$ Constant R = 0.1 Load Reduction Constant $\Delta K = 7.0$ ksi in$^{1/2}$			

a (inch)	N (cycles)	ΔK (ksi in$^{1/2}$)	da/dN (inch/cycle)	Test condition
0.716	367,745	0.00	0.00E+00	Constant $\Delta K = 5.90$ ksi in$^{1/2}$
0.734	668,775	5.79	3.49E-08	
0.741	868,781	5.79	3.95E-08	
0.747	1,068,776	5.80	3.24E-08	
0.754	1,268,782	5.80	3.14E-08	
0.760	1,468,807	5.81	3.05E-08	
0.766	1,668,907	5.81	2.98E-08	
0.772	1,868,942	5.81	2.96E-08	
0.778	2,068,942	5.82	2.98E-08	
0.783	2,269,002	5.82	2.99E-08	
0.790	2,469,143	5.83	3.00E-08	
0.796	2,669,265	5.83	3.00E-08	
0.802	2,869,006	5.83	2.97E-08	
0.808	3,069,230	5.84	2.93E-08	
0.813	3,269,550	5.84	2.89E-08	
0.819	3,469,895	5.84	2.86E-08	
0.825	3,670,244	5.85	2.81E-08	
0.831	3,869,621	5.85	2.79E-08	
0.836	4,069,058	5.85	2.78E-08	
0.841	4,269,711	5.86	2.80E-08	
0.847	4,471,790	5.86	2.85E-08	
0.853	4,672,369	5.87	2.93E-08	
0.859	4,874,307	5.87	2.97E-08	
0.865	5,072,945	5.87	3.02E-08	
0.871	5,269,915	5.88	3.05E-08	
0.877	5,471,935	5.88	3.04E-08	
0.883	5,673,955	5.88	3.02E-08	
0.889	5,875,975	5.89	2.99E-08	
0.895	6,072,945	5.89	2.95E-08	
0.901	6,269,915	5.89	2.87E-08	
0.907	6,471,935	5.90	2.73E-08	
0.912	6,673,955	5.90	2.52E-08	
0.918	6,875,975	5.90	2.27E-08	
0.922	7,072,945	5.90	2.03E-08	
0.925	7,269,915	5.90	2.00E-08	
0.928	7,471,935	5.91	1.97E-08	
0.932	7,673,956	5.91	1.89E-08	
0.938	7,875,979	5.91	1.75E-08	
0.941	8,072,950	5.91	1.62E-08	
0.943	8,269,922	5.91	1.46E-08	
0.945	8,471,942	5.91	1.31E-08	
0.948	8,673,962	5.92	1.33E-08	
0.951	8,875,982	5.92	1.29E-08	

0.954	9,072,952	5.92	1.12E-08	
0.956	9,269,922	5.90	8.25E-09	Constant R = 0.1 Load Reduction
0.958	9,514,175	5.90	4.45E-09	
0.958	9,669,453	5.88	2.46E-09	
0.958	9,869,454	5.88	7.67E-10	
0.958	10,069,381	5.88	2.11E-10	
0.958	10,268,954	5.88	2.86E-10	
0.958	10,469,046	5.88	3.19E-10	
0.958	10,669,430	5.88	1.31E-10	
0.958	10,870,783	5.88	-1.78E-10	
0.958	11,071,294	5.88	-5.94E-10	
0.958	11,272,251	5.88	-1.44E-09	
0.957	11,472,640	5.88	-1.58E-09	
0.957	11,672,436	5.89	-1.39E-09	
0.956	11,874,456	5.89	-1.04E-09	
0.956	12,076,476	5.90	-6.25E-10	
0.957	12,273,445	5.89	-1.89E-10	
0.957	12,470,415	5.89	2.22E-10	
0.957	12,672,436	5.89	1.73E-10	
0.957	12,874,456	5.89	9.44E-11	
0.957	13,076,476	5.89	8.60E-11	
0.957	13,273,445	5.89	1.19E-10	
0.957	13,470,415	5.89	1.40E-10	
0.957	13,672,436	5.89	2.08E-10	
0.957	13,874,456	5.89	1.92E-10	
0.957	14,076,476	5.89	2.20E-10	
0.957	14,273,445	5.89	2.04E-10	
0.957	14,470,415	5.89	9.08E-11	
0.957	14,672,436	5.89	-3.86E-11	
0.957	14,874,456	5.89	-1.03E-10	
0.957	15,076,476	5.89	-1.16E-10	
0.957	15,273,445	5.89	-1.11E-10	
0.957	15,470,415	5.89	-6.20E-11	
0.957	15,672,436	5.89	9.28E-11	
0.957	15,874,456	5.89	9.55E-11	
0.957	16,076,476	5.89	6.45E-11	
0.957	16,273,445	5.89	6.61E-11	
0.957	16,470,415	5.89	-1.23E-11	
0.957	16,672,436	5.89	4.90E-11	
0.957	16,874,456	5.89	6.33E-11	
0.957	17,076,476	5.89	2.24E-10	
0.957	17,273,444	5.89	2.86E-10	
0.957	17,470,414	5.89	3.03E-10	
0.957	17,672,436	5.89	2.06E-10	
0.957	17,874,456	5.89	7.56E-12	
0.957	18,076,476	5.89	-8.25E-11	
0.957	18,273,444	5.89	-1.27E-10	
0.957	18,470,414	5.89	-2.18E-10	
0.957	18,672,436	5.89	-8.74E-11	
0.957	18,874,456	5.89	-4.24E-11	

0.957	19,076,476	5.89	2.62E-11
0.957	19,273,444	5.89	-3.31E-11
0.957	19,470,414	5.89	-1.84E-10
0.957	19,672,436	5.91	-5.14E-10
0.957	19,874,458	5.92	-7.27E-10
0.957	20,076,478	5.94	-5.18E-10
0.956	20,273,448	5.94	-2.43E-10
0.956	20,470,418	5.94	-3.09E-11
0.957	20,672,438	5.95	4.46E-11
0.957	20,874,458	5.95	5.13E-11
0.957	21,076,478	5.95	-2.08E-10
0.956	21,273,448	5.94	-1.99E-10
0.956	21,470,420	5.94	-3.95E-11
0.956	21,672,442	5.94	2.39E-10
0.957	21,874,462	5.94	4.02E-10
0.957	22,076,482	5.95	3.65E-10
0.957	22,273,452	5.95	2.31E-10
0.957	22,470,422	5.95	7.42E-11
0.957	22,672,442	5.95	2.07E-10
0.957	22,874,462	5.95	1.78E-10
0.957	23,076,482	5.95	3.14E-11
0.957	23,273,452	5.95	-1.20E-10
0.957	23,470,426	5.95	-2.10E-10
0.957	23,672,446	5.95	-1.55E-10
0.957	23,874,466	5.95	-6.07E-11
0.957	24,076,486	5.95	1.18E-10
0.957	24,273,454	5.95	2.14E-10
0.957	24,470,426	5.95	1.89E-10
0.957	24,672,446	5.95	5.45E-11
0.957	24,874,466	5.95	-9.09E-11
0.957	25,076,486	5.95	-1.01E-10
0.957	25,273,454	5.95	-9.60E-11
0.957	25,470,426	5.95	-8.82E-11
0.957	25,672,446	5.95	3.77E-11
0.957	25,874,466	5.95	-3.92E-11
0.957	26,076,486	5.95	-4.82E-11
0.957	26,273,454	5.95	-1.43E-10
0.957	26,470,426	5.95	-1.87E-10
0.957	26,672,446	5.95	-2.87E-10
0.957	26,874,466	5.95	-2.18E-10
0.957	27,076,486	5.94	1.75E-11
0.956	27,273,454	5.95	5.26E-11
0.957	27,470,426	5.95	7.45E-11
0.957	27,672,446	5.95	-4.94E-11
0.957	27,874,466	5.95	-8.74E-11
0.957	28,076,486	5.94	-1.81E-10
0.956	28,273,454	5.94	1.12E-10
0.956	28,470,426	5.94	4.27E-10
0.956	28,672,446	5.95	6.91E-10
0.957	28,874,466	5.95	7.82E-10

0.957	29,076,486	5.95	7.32E-10	
0.957	29,273,454	5.95	6.00E-10	
0.957	29,470,426	5.95	2.93E-10	
0.957	29,672,446	5.95	1.60E-10	
0.957	29,874,466	5.95	1.08E-10	
0.957	30,076,486	5.95	4.86E-11	
0.957	30,273,454	5.95	-3.54E-11	
0.957	30,470,426	5.95	-9.44E-11	
0.957	30,672,446	5.95	-2.42E-10	
0.957	30,874,466	5.95	-4.83E-10	
0.957	31,076,486	5.95	-5.59E-10	
0.957	31,273,454	5.95	5.43E-10	
0.957	31,470,426	5.95	1.39E-09	
0.957	31,672,446	6.38	2.19E-09	Constant $\Delta K = 7.0$ ksi in$^{1/2}$
0.959	31,969,445	6.43	2.50E-09	
0.959	32,168,942	6.86	1.64E-09	
0.960	32,369,449	6.91	6.07E-10	
0.959	32,568,795	6.91	-6.67E-10	
0.959	32,771,063	6.91	-2.39E-10	
0.959	32,971,447	6.91	3.66E-09	
0.959	33,071,638	6.91	7.08E-09	
0.959	33,270,582	6.91	1.50E-08	
0.964	33,471,696	6.91	2.43E-08	
0.971	33,671,900	6.92	2.92E-08	
0.978	33,873,232	6.92	3.26E-08	
0.986	34,077,732	6.93	3.37E-08	
0.991	34,274,700	6.93	3.42E-08	
0.997	34,471,672	6.93	3.52E-08	
1.005	34,673,692	6.94	3.59E-08	
1.013	34,875,712	6.94	3.61E-08	
1.021	35,077,732	6.95	3.38E-08	
1.027	35,274,704	6.95	2.99E-08	
1.033	35,471,676	6.95	2.53E-08	
1.037	35,673,696	6.95	2.06E-08	
1.041	35,875,716	6.96	1.71E-08	
1.044	36,077,740	6.96	1.44E-08	
1.046	36,274,708	6.96	1.33E-08	
1.048	36,471,676	6.96	1.28E-08	
1.051	36,673,696	6.96	1.24E-08	
1.054	36,875,716	6.96	1.26E-08	
1.057	37,077,740	6.96	1.24E-08	
1.058	37,274,712	6.97	1.17E-08	
1.061	37,471,680	6.97	1.04E-08	
1.063	37,673,700	6.97	9.13E-09	
1.065	37,875,720	6.97	8.09E-09	
1.066	38,077,744	6.97	6.45E-09	
1.067	38,274,712	6.97	5.16E-09	
1.069	38,471,680	6.97	4.30E-09	
1.069	38,673,704	6.97	3.64E-09	
1.069	38,875,724	6.97	3.17E-09	

1.070	39,077,744	6.97	3.09E-09
1.071	39,274,716	6.97	3.66E-09
1.072	39,471,684	6.97	4.24E-09
1.072	39,673,704	6.97	4.83E-09
1.073	39,875,724	6.97	5.25E-09
1.075	40,077,744	6.97	5.64E-09
1.076	40,274,716	6.97	6.06E-09
1.077	40,471,684	6.98	6.68E-09
1.078	40,673,704	6.98	7.67E-09
1.080	40,875,724	6.98	9.33E-09
1.082	41,077,744	6.98	1.17E-08
1.084	41,274,716	6.98	1.40E-08
1.087	41,471,684	6.98	1.59E-08
1.091	41,673,704	6.98	1.67E-08
1.095	41,875,724	6.99	1.69E-08
1.098	42,077,744	6.99	1.61E-08
1.101	42,274,716	6.99	1.46E-08
1.104	42,471,684	6.99	1.29E-08
1.107	42,673,704	6.99	1.11E-08
1.109	42,875,724	6.99	9.32E-09
1.110	43,077,744	6.99	7.72E-09
1.111	43,274,716	6.99	6.61E-09
1.112	43,471,684	6.99	5.85E-09
1.114	43,673,704	6.99	5.21E-09
1.115	43,875,724	7.00	4.73E-09
1.116	44,077,748	7.00	4.26E-09
1.116	44,274,716	7.00	3.89E-09
1.117	44,471,688	7.00	3.81E-09
1.118	44,673,708	7.00	3.88E-09
1.119	44,875,728	7.00	3.99E-09
1.119	45,077,748	7.00	4.58E-09
1.120	45,274,716	7.00	4.99E-09
1.121	45,471,688	7.00	5.01E-09
1.123	45,673,712	7.00	4.79E-09
1.124	45,875,732	7.00	4.38E-09
1.124	46,077,752	7.00	3.82E-09
1.125	46,274,720	7.00	3.10E-09
1.125	46,471,692	7.00	2.93E-09
1.126	46,673,712	7.00	2.83E-09
1.127	46,875,732	7.00	2.80E-09
1.127	47,077,752	0.00	0.00E+00

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14. ABSTRACT
This report describes the results of a research program to determine the damage tolerance properties of metallic propeller materials. Three alloys were selected for investigation: 2025-T6 Aluminum, D6AC Steel and 4340 Steel. Mechanical response, fatigue (S-N) and fatigue crack growth rate data are presented for all of the alloys. The main conclusions that can be drawn from this study are as follows. The damage tolerant design of a propeller system will require a complete understanding of the fatigue crack growth threshold. There exists no experimental procedure to reliably develop the fatigue crack growth threshold data that is needed for damage tolerant design methods. Significant research will be required to fully understand the fatigue crack growth threshold. The development of alternative precracking methods, evaluating the effect of specimen configuration and attempting to identify micromechanical issues are simply the first steps to understanding the mechanics of the threshold.

15. SUBJECT TERMS
DCB specimen; Simple beam theory; Z-fibers; Delamination prediction; Release rate; Strain energy

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